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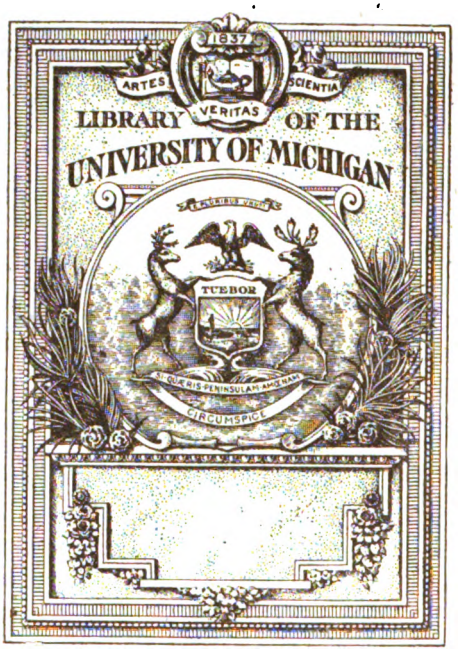

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Popular Science Monthly

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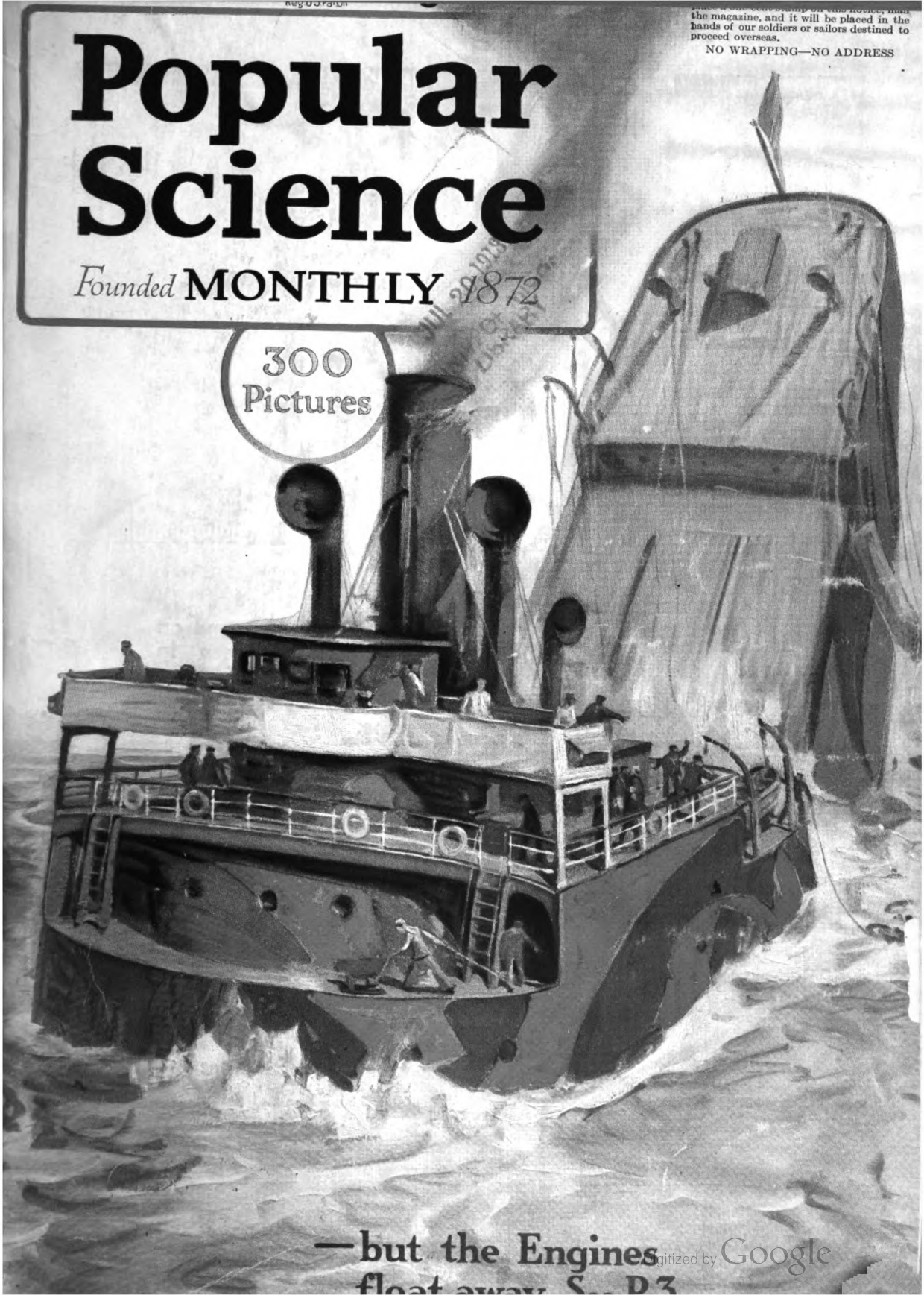
the magazine, and it will be placed in the hands of our soldiers or sailors destined to proceed overseas.

NO WRAPPING—NO ADDRESS

Popular Science

Founded MONTHLY 1872

300 Pictures



—but the Engines float away. See P. 3

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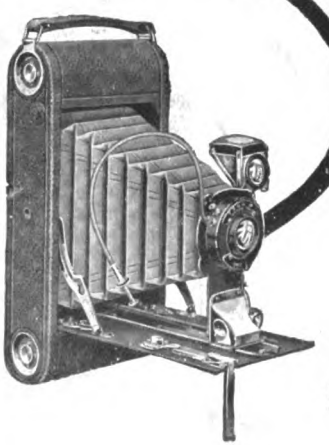
SENECA CAMERAS



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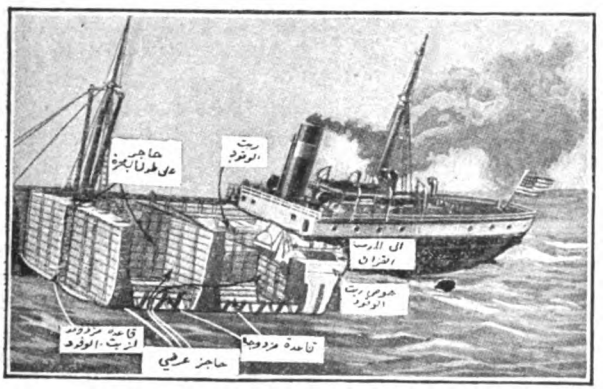
How We Look in Arabic

اخبار علمية وصناعية

﴿ سفن لا تخشى الطوربيد ﴾ طالعنا اخيراً بين اخبار الحرب أن الاميركيين شرعوا في انشاء سفن لا تخشى الطوربيد . وقد تساءل الكثيرون عن حقيقة هذا الخبر وشكوا في صحته . ومن حسن حظنا اننا اطلعنا على مقالة في احدى المجلات الاميركية فيها وصف لتلك السفن المراد انشاؤها وبيان موجز عن المبدأ الذي تبنى عليه فرأينا تلخيص ذلك في الهلال



قطع خيالي في احدى السفن التي لا تخشى الطوربيد

لا يقصد من قولنا هذا ان تلك السفن لا يمكن اغراقها ابداً فانما هي لا تغرق اذا أصيبت بطوربيد واحد ولكنها اذا اصيبت بطوربيدين او اكثر في مواضع رئيسية فلا مناص من غرقها . وانما يتعذر ذلك على الغواصة لانها بعد اطلاق الطوربيد الاول لا يمكنها الصعود ثانية الى وجه الماء لاطلاق طوربيد ثانٍ من غير أن تتعرض لمدافع السفينة

وهذه السفن مبنية على مثال السفن الناقلة لزيوت الوقود . فان هذه السفن مقسومة الى احواض كثيرة يبلغ عددها ١٢ حوضاً او اكثر بواسطة حاجز منيع على طول السفينة

"Al Hilal" is a scientific and literary review published in Cairo, Egypt. Recently it republished an article of ours on the Donnelly wooden ship. We thought it might interest our readers to see how we look in Arabic; and so we have reproduced in facsimile the first page of Al Hilal's rendering of our article. An Arabic friend tells us that Al Hilal is edited by George Zaidan. Alas! George has not given us credit.

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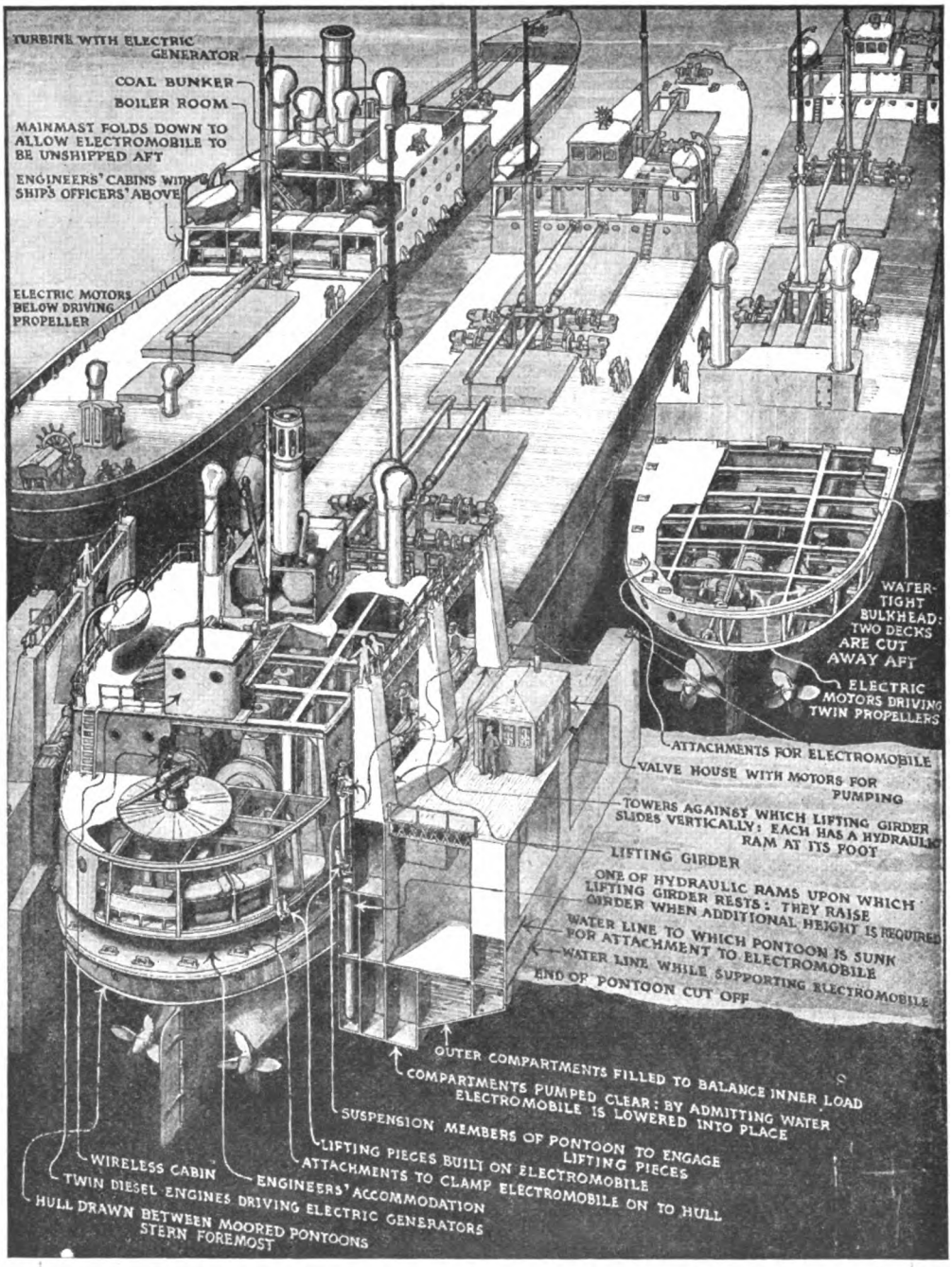
Changing the Engines



An English engineer, H. de M. Snell, suggests that much of the time and therefore the money now lost by holding a ship in port for several days in order to unload and take on cargo, might be saved if detachable powerplants were used. By means of pontoons, he would lift an engine-containing hull from a newly arrived vessel and drop it in one ready to depart. The actual lifting is done by means of hydraulic rams on the pontoons. The engine-hull is water-tight and is therefore able to float. If the ship should be torpedoed it would be easy to unhook the engine-hull so that it could float off in safety in the manner shown by our cover design. This engine-hull may also be placed amidships

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Changing Engines Like a Suit

How H. de M. Snell would use detachable power plants to reduce the expense of loading a vessel and how his plan would help to save lives at sea

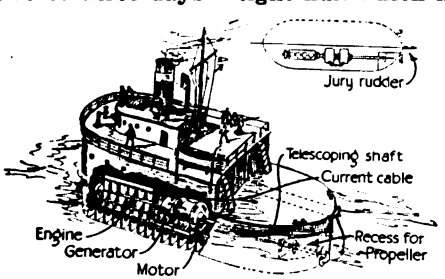
By Joseph Brinker

THE *Great Eastern* was the most daring experiment in shipbuilding made in the nineteenth century. She was a financial failure. Why? Not because she was too big for her time, but because her time was inefficient. The wharves of our ports had no adequate means for loading and unloading so huge a hull; no adequate means for collecting enough freight in a short period. And so she would be held in New York for weeks, waiting for a cargo big enough to fill her capacious hold. Thousands and thousands of dollars were lost each trip by enforced idleness.

Ships are no longer held in port for weeks. Hence the *Great Eastern's* financial failure is not repeated. But for all that there is still costly delay. Every time a ship ties up for two or three days to load and unload, its idle powerplant is an investment which is not paying full dividends.

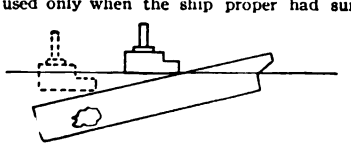
To eliminate this economic waste H. de M. Snell, a British engineer, has made a daring suggestion. He would use an electric powerplant which can be kept in continuous operation by the simple expedient of taking it from one ship as soon as it enters port to unload and installing it in another loaded ship ready to leave port. This principle is original in ship construction, yet very old in other forms of transportation, as for instance the railroad with its detachable powerplant in the form of the giant steam locomotive and its long train of freight cars which can be loaded or unloaded while the locomotive is busy elsewhere earning dividends by actually moving goods. Why not apply the same principle to a ship? Why should a ship's costly powerplant be kept idle while she is loading and unloading, simply because the ship travels in water and the locomotive on land? In effect, Mr. Snell would make a freight car out of a cargo ship.

He accomplishes this result by mounting a portion of the ship's powerplant consisting of twin Diesel engines and electric generators in a flat-bottomed, tight hull which may be set down on the upper deck of the boat, either amidships or at the stern, and held rigidly in place by means of clamps. The Diesel engines drive electric generators, the current from which is carried by means of cables to electric motors far down in the hull of the vessel. The motors drive twin propellers through gearing. Both motors and propellers are fixtures; they are not removed with the generating powerplant, the break in the connection between the two being made in the current-carrying cable from



The Engine Hull Floating by Itself

The detachable watertight engine-containing hull could be made self-propelling as here shown. The motors and propellers would be supplied. The propellers would be carried on telescoping shafts and used only when the ship proper had sunk



The dotted lines show how the powerplant hull would float off when the ship is torpedoed

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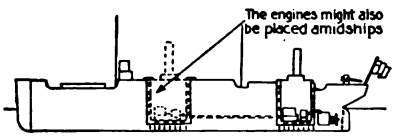
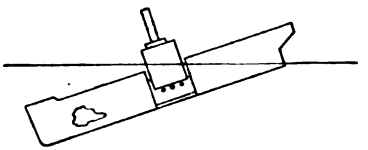
the generators to the electric motors.

And now let us suppose that a steamship constructed as Mr. Snell conceives enters New York. What happens? Two pontoons with lifting girders range themselves on either side of the ship. By means of powerful hydraulic hoists the hull containing the engines is lifted bodily. Very much the same principle is followed in raising much heavier submarine boats into their "mother" ships. The pontoons transfer the suspended engine-containing hull to a waiting loaded ship, and drop it into place.



Snell intends to place the engines at the stern, but as the dotted lines show they might also be placed amidships

Mr. Snell's system has an advantage which should not be overlooked. The engine-hull is water-tight; therefore, it is able to float. Suppose the ship were to be torpedoed, it would be no difficult matter to unhook the hull so that it could float off in safety in the manner shown by our cover design. Mr. Snell has not supplied independent propellers for his engine-containing hull, although he has supplied quarters for the crew. We have, therefore, shown in one of the accompanying drawings, how the powerplants can be made self-propelling. It would be necessary merely to add two motors and two propellers, the propellers to be carried on telescoping shafts and to be used only when the ship proper has sunk. At other times they would be carried in small recesses in the powerplant hull, so that they would not interfere with transference from one ship to another.



How the engines amidships would float off when the ship is torpedoed

To go a step further and overcome any objections which might be raised against placing such a large deadweight as a heavy powerplant on the upper deck of a vessel and making it top heavy when no cargo is carried, it would seem possible to insert the hull carrying the generating powerplant, whether located at the stern or amidships, entirely within the ship proper by placing smaller roller wheels at the front and rear and the bottom of the inserted hull.

Mr. Snell's idea discloses a vista of great possibilities. The system he proposes may be improved and developed along practical lines. The engine-hull will, in course of time, be transferred from one ship to another with scientific precision and mathematical accuracy.

Motor Trucks May Be Equipped with Pneumatic Tire

"WILL you have it sent by railroad or motor truck freight?" This is the question that may be asked of shippers as a result of the use of pneumatic instead of solid tires for automobile trucks. The prediction that the truck may become a competitor of the railroads is based on the fact that the pneumatic tire takes away the limits as regards speed that were imposed on the truck by the solid rubber band.

Pneumatic tires were formerly restricted as to size, but this limit no longer prevails, provided laminated cords without cross weaves are used instead of woven fabric. These cords stand strains without difficulty. The speed and the distance traveled by vehicles equipped with pneumatic tires have been increased and the upkeep costs reduced. Trucks with pneumatic tires can be operated through sand, mud and snow, where solid tired vehicles would be stalled.

Pneumatic tires like that shown in this photograph may now be used for trucks

On account of the growing demand for more transportation facilities due to war conditions anything that will enable the heavy motor truck to keep down expense and add to its speed and the distance it can travel will be welcome.

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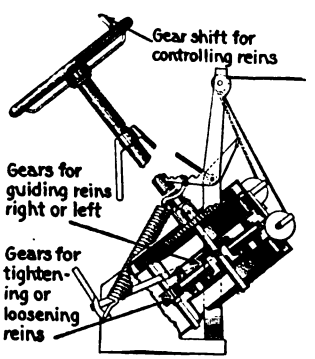
Here's the Near-Auto—as Near As a Horse Can Be One

THE honors for the first attempt to modernize quadrupeds will go to Lynn S. Pace, located in the progressive town of Cisco, Utah. Incidentally ground has been broken in a new field of invention.

Horse, auto, 50-50. This is the basis of Lynn's invention. He argues that it is not necessary to hold the reins in your hands when you drive a horse. The reins could just as well be wound around a pair of drums controlled by a steering-wheel—such as you see on automobiles. The wheel is connected to a gear mechanism which is actuated to simultaneously rotate the above mentioned drums in opposite directions to tauten the reins, and both in the same direction to wind one of the reins while the other rein is unwound.

Such an attachment will furnish you with all the pleasures of driving an automobile minus the attendant dangers.

One might suggest a few improvements which would greatly enhance the value of Mr. Lynn's device. For instance, let a crank be inserted in the horse's chest, which you turn a few times before you start out on your near-auto spin. The horse could also be trained to "honk" at street crossings.



Let your imagination revel in this make-believe auto! Why buy a limousine when a horse does as well?

Poor teacher is having her troubles in giving these triplets their right names and telling one from another

Which Is Gertrude, Which Is Grace and Which Is Genevieve?

ALIKE even to the last freckle on their noses, the Wildey sisters, of Oak Park, Illinois, present a continuous problem to their teacher, and even to their mother—not to mention prospective difficulties for the young men who, a few years hence, will be paying them attentions and will be unable to make an intelligent choice.

The three girls, Gertrude, Grace, and Genevieve, are eleven years old. So far they have missed only half a day of school, but as all were absent at the same time the teacher was not perplexed. It is not recorded that any of the triplets ever acted any differently from the other two.

The three girls dress alike, walk alike, talk alike, study alike, and get grades alike—perhaps because the harassed teacher quits trying to figure out which is which and lumps their work together.

There is sure to be an interesting future for these pretty triplets.

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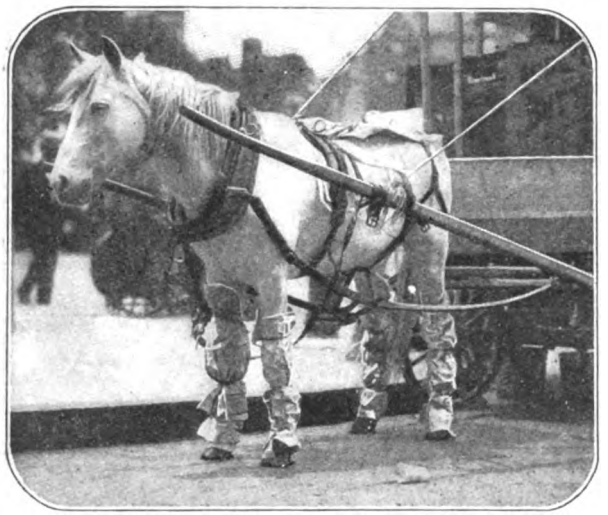


Makeshift stockings made of newspapers to protect the horse's legs from the flies that annoy in summer

Newspaper Used as Socks for Horses. They Keep the Flies from Biting

HORSES often suffer acutely from the annoyance of flies. Not only during the day, but often during the night the stamp, stamp, stamp which is heard in the stables tells the story of faithful animals unable to rest on account of the pestering insects.

The owner of the horse shown in the accompanying illustration resorted to the expedient of wrapping newspapers around the animal's legs. This undoubtedly served the purpose, but only the horse could decide whether the heat from the paper was less hard to endure than the annoyance of the flies. No doubt the newspaper shade over the animal's back was appreciated, since it kept off the sun and did not keep out the air.

Another lover of horses uses the sleeves of discarded shirts to protect the horses' legs, just like stockings.

Stockings made of cheese cloth have often been similarly used.

Keeping Musicians' Hands in Trim with Finger Stretcher

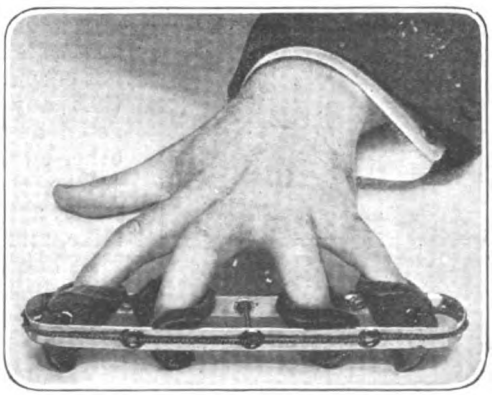
A SIMPLE device for accelerating the progress of a musician in mastering his instrument has recently been invented by Kanute I. Finney of Chicago, Ill. Such well-known soloists as Jascha Heifetz, Godowsky, Eddy Brown and Jacques Thibaud have utilized the device to keep their hands in their accustomed flexible condition on tour, when it was not practicable to spend the customary time at practise on an instrument.

The device consists of a frame with eyes through which are run cords attached to soft pads, four in number. Against each pad one finger may be placed and the hand then moved from a straight, open position to a curved, closed position to flex the muscles and accustom the fingers to long stretches, or to keep them in condition if used by an artist whose hand is perfectly trained.

The felt pads are adjustable. It is necessary merely to loosen or tighten the silk cord which encircles the metal frame to accomplish the adjustment. The device weighs less than three ounces and can be easily carried in the pocket. It can be used to advantage not only by violinists and pianists, but even by typists who desire to acquire speed more rapidly than by following the usual methods of practice.

The accompanying illustration shows the contrivance in operation. The four fingers are imprisoned in the soft pads which are easily adjusted by loosening or tightening the silk cord which runs outside of the frame. All you have to do is to work your hand to get desired result.

The finger stretcher will not enable you to rival Paderewski; but it will help some.



This finger stretcher will keep your digits flexible and supple—in condition to play

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Spectacles That Furnish Their Own Light

L. ZACHARA, of Bremerton, Wash., was often hampered in his occupation by the lack of proper light. He wanted light on the object on which he was working. No shadows should interfere with clear vision. On the other hand, his eyes had to be protected from its direct rays. So he hit upon the expedient of attaching to the spectacle frame one or more electric filament lamps which are supplied with electricity from a battery or an ordinary lighting circuit. Wide frames of an opaque material protect the eyes from the direct rays of the incandescent lamp. This lamp is located between the eyes or set in the rim surrounding the eye, as shown in the accompanying illustration.

Spectacles whose attached lights are shaded from the eyes and thrown on objects

Reading the Meter from the Outside

ALL the inconvenience that results when the meter reader finds nobody at home or rings the bell and calls the housewife away from her work is eliminated by a new type of meter box which is so placed that the meter may be read without entering the house at all. The device also eliminates the necessity for a flash light, and for climbing inconvenient places to be able to read the dials. The number of readings that may be made by one man is increased a hundred per cent. or more. The meter may also be "blocked" or sealed when a tenant moves, or tested when desirable. Although the meter can be read by anybody at any time, it cannot be tampered with. Its adoption will be a great advantage to gas companies.

This meter saves both time and annoyance to the busy housewife

How the British "Tanks" Received Their Name

BECAUSE a fellow of the Royal Historical Society has unintentionally misled the British public, as to the origin of the famous "tanks," Sir William Tritton, who designed and built them, has published the real story of their name. It seems that in the early days of the war, Sir William Tritton's firm made some tractors for hauling heavy howitzers. Admiral Bacon, then Managing Director of the Coventry Ordnance Works, expressed regret that they would not cross trenches. That made Sir William think. He thought with such success that he produced a tractor known as "Little Willie." Since it was obviously inadvisable to herald "Little Willie's" reason for existence to the world, he was known as the "Instructional Demonstration Unit." "Little Willie's" hull was called in the shop orders a "water carrier for Mesopotamia;" no one knew that the hull was intended to be mounted on a truck. Naturally, the water carrier began to be called a "tank." So the name came to be used by managers and foremen of the shop, until now it has a place in the army vocabulary and will probably be so known in history for all time.

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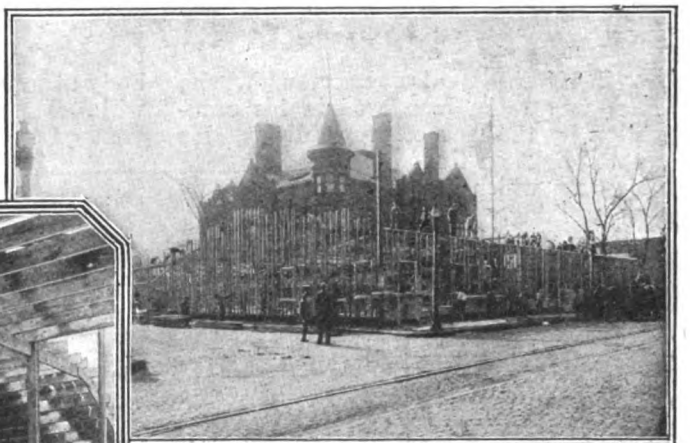
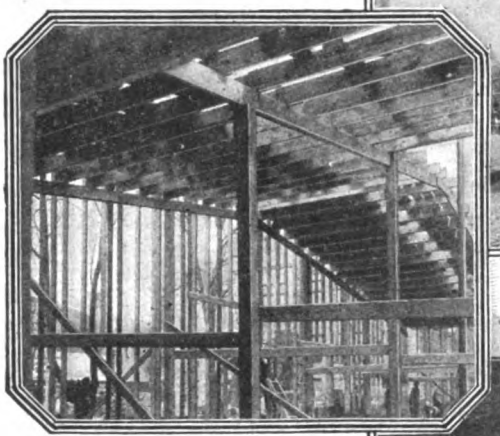
How Liberty Hall, a $15,000 Structure in Hammond,

After Two Hours

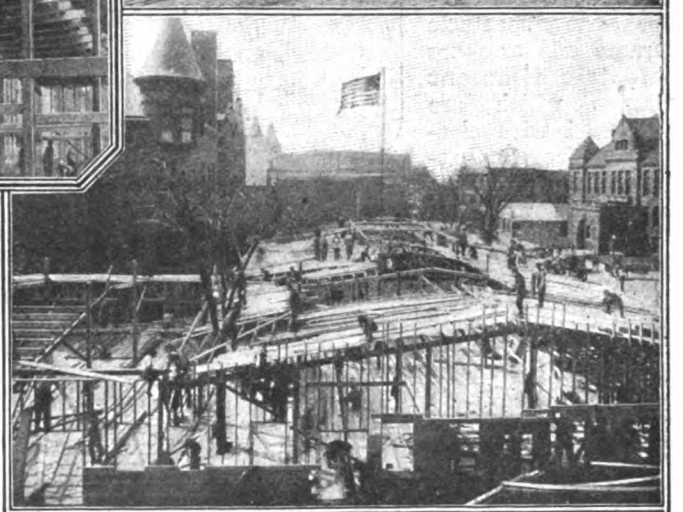
At nine o'clock the studding was nearly all up, some of the rafters were in place and a start had been made in putting on the sheeting





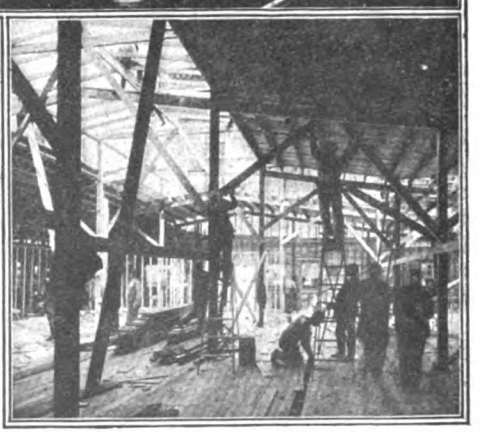
What System Will Do

The 225 workingmen, who built Liberty Hall, were organized in units of nine men each. This picture shows what one of the units had accomplished by 8:30 o'clock



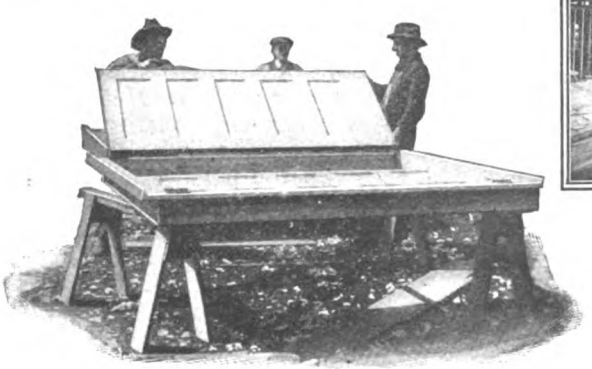
At the Turn of the L

This shows the junction of the two sides of the L at 10 o'clock. The flooring was nearly all down, the sheeting more than half in place and siding on two sides half way up



A Double Door Unit

Two carpenters putting the finishing touches on a double door unit. This unit, when carried to the building, was permanently put in place hinged and screwed on in less than five minutes



Making Rapid Progress

This interior view, taken at 11 o'clock, shows in the background the studding going up for the stage. The sheeting is nearly all on, and many of the doors and windows set up in their frames and securely fixed

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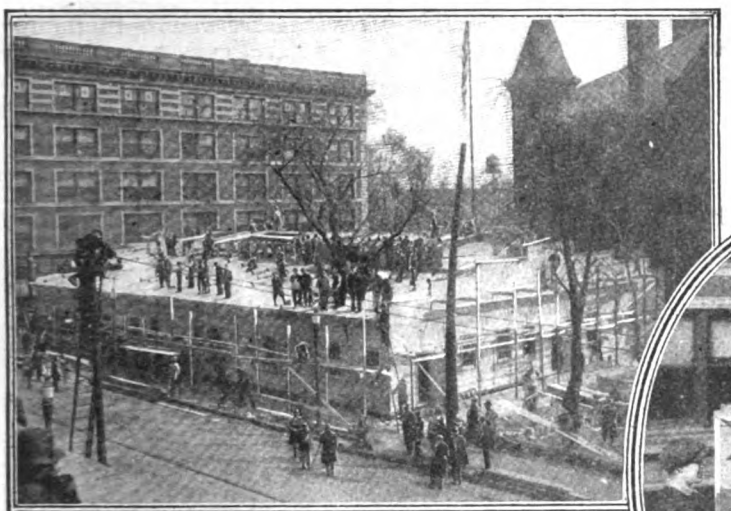
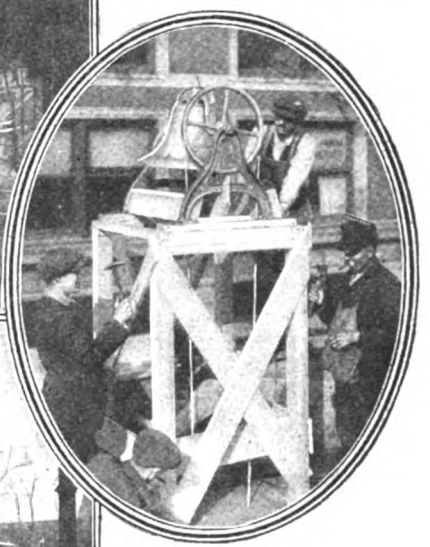
Ind., Was Completely Built in A Single Day



Ahead of the Schedule

At noon the work on the building was 1½ hours ahead of the schedule. The siding was practically all on, doors and windows in place and work on the roof was progressing rapidly



Liberty Bell in Place

When the building was completed the Liberty Bell shown here proclaimed this fact to the people. On the evening of that day, March 3, 1918, a dance was given in the building

Busy as a Bee Hive

At two o'clock the roof was practically complete, the painters were half done with their work and the interior work was making rapid progress. The hall was filled with busy workers

Nearing the End

At half past three the outside was practically completed. The scaffolding was taken down and the cupola was finished—ready for the Liberty Bell

Patriotic "Lady Carpenters"

A unit composed of six women carpenters assisted in building the hall and subscribed for a $50.00 Liberty Bond

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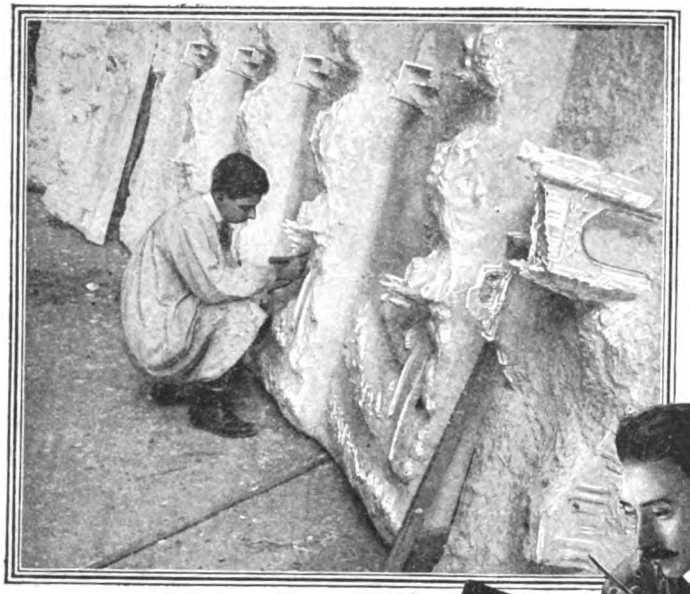
Reproducing the France in Minia- How Sculptor and Represent War's



This photograph shows one stage of the making of models, a number of them being placed against a wall to allow the plaster to dry. The sculptor is adding details which were incomplete in the original mold—putting a finishing touch here and there

Photos © Brown and Dawson

The sculptor is here pictured reproducing in miniature a cathedral as it appeared after it had been bombarded by German guns. The latest photographs taken of the ruins were placed at the disposal of the sculptor so that the work might be correct in all the essential particulars

No effort is spared to make the models realistic. After a miniature representation in plaster of the cathedral ruins had been completed a smoke torch was actually applied in order to produce the charming effect of the Teutonic shells

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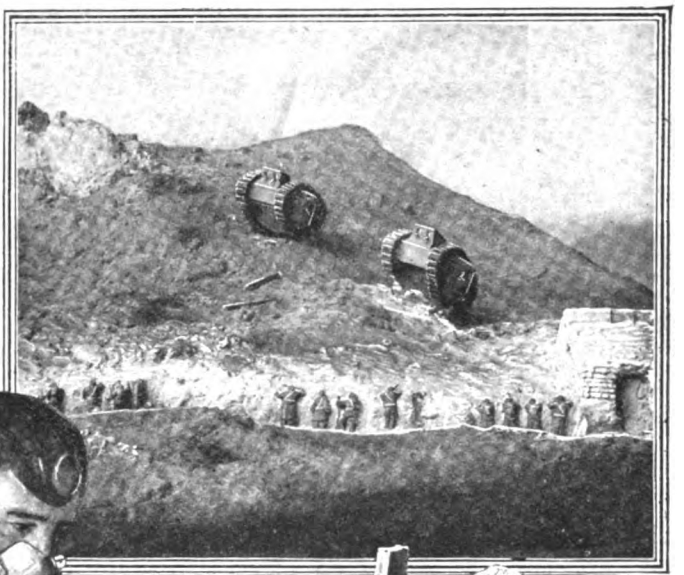
Battlefields of ture Models— Artist Work to Devastation



This model illustrates a battlefield in the Aisne sector with British tanks advancing across No Man's Land to lead the attack on Germans in the trenches in the foreground. The sculptor has even gone to the pains to reproduce small objects on the ground

This is the manner in which red brick coloring is applied to the white plaster model of a cathedral partly demolished by German shells. In order to produce the desired effect it is necessary to use an air brush as shown. The operator wears a gas mask so as not to inhale the spray of paint

Twenty thousand cars a day is the output of the automobile department of the model factory. These automobiles are modeled exactly after the various types of Liberty trucks. An artist paints them a gray color to make them conform with machines which served as models

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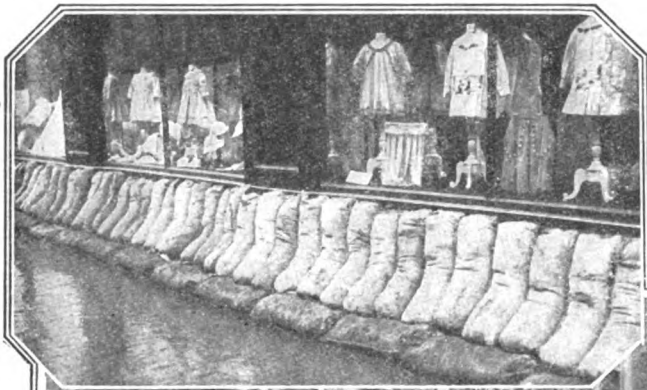
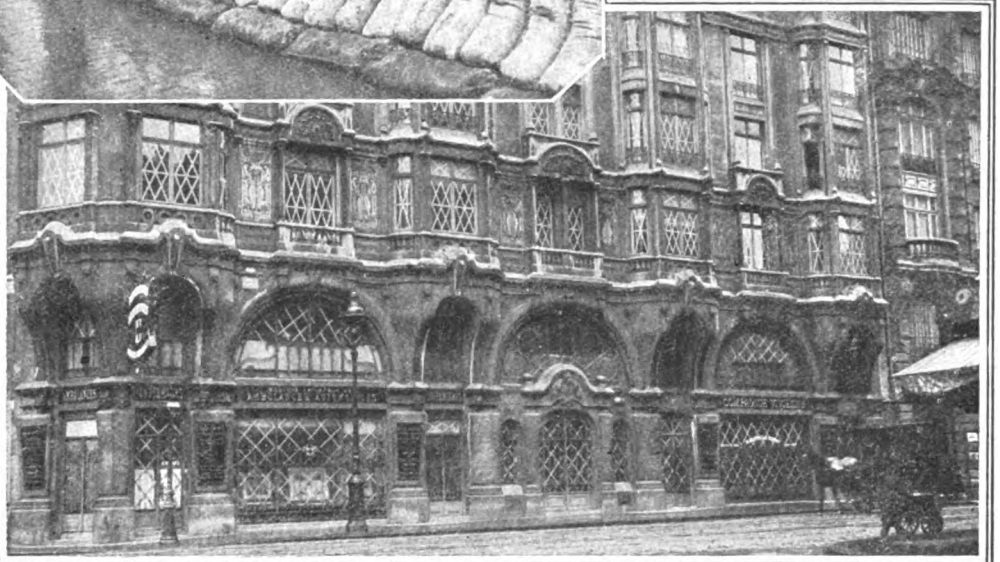
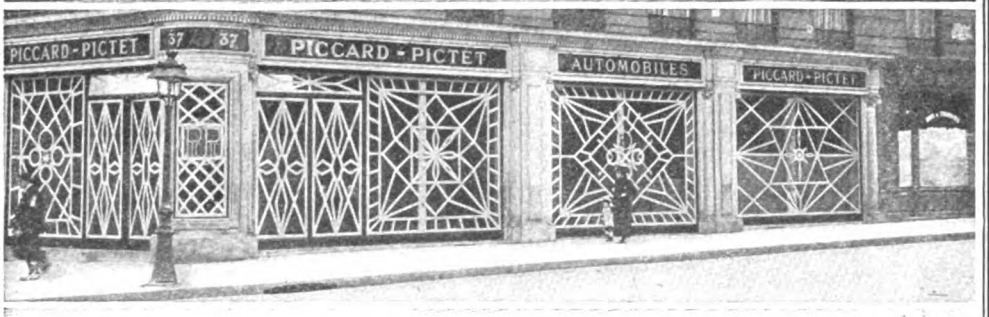
How Paris Protects Itself from Air Raiders



These sand bags were placed before the windows of cellars where residents of the city sought refuge from the bombs and shells

The concussion from the shells is terrific. Strips of paper are placed on the windows to prevent breaking glass from doing harm





Photos © Kadel and Herbert

Above is shown an example of elaborate paper stripping protection for windows Below are pictured statues and pavilions shielded by sand bags from the shells

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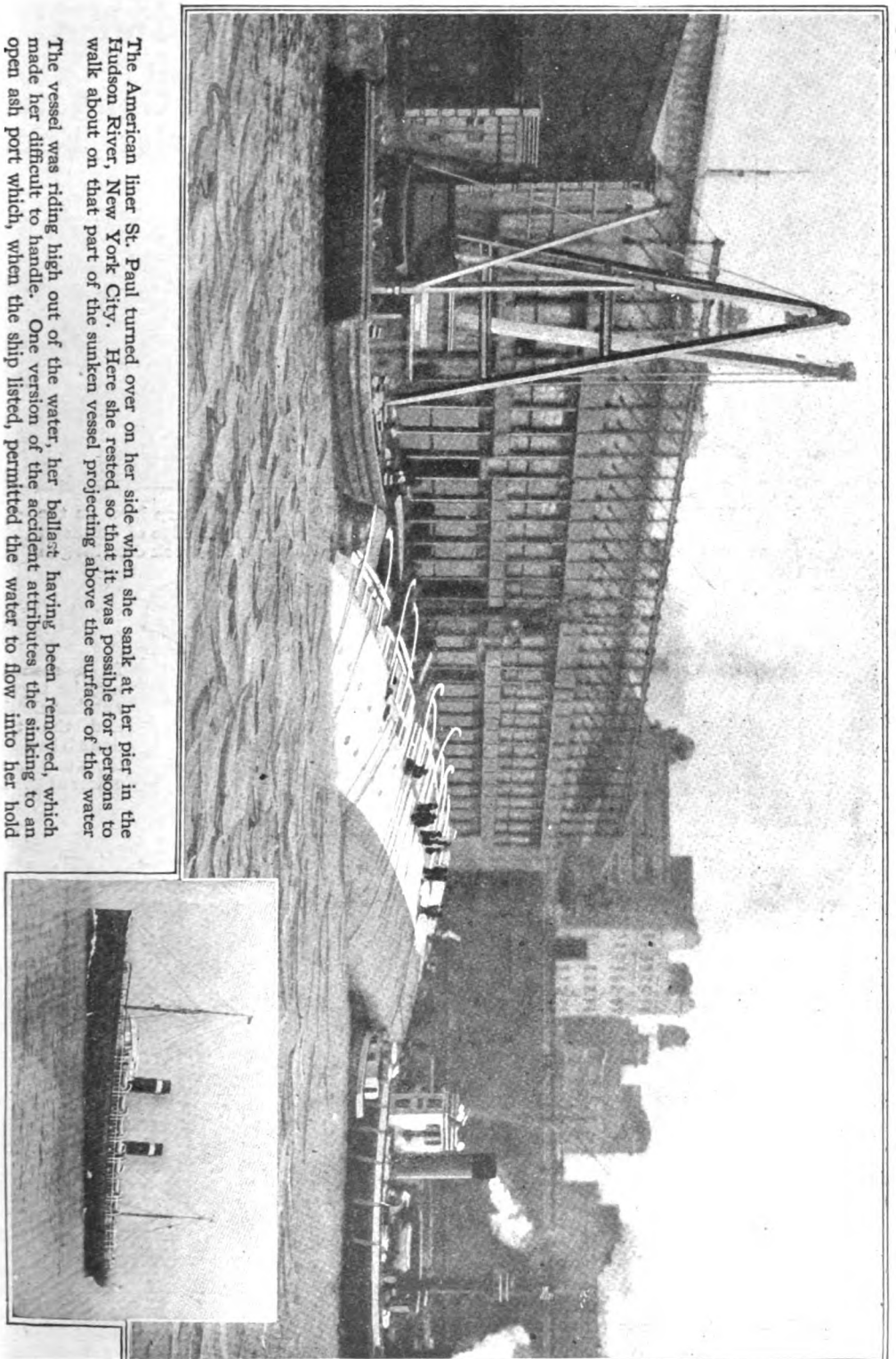
She Sank At Her Pier



The American liner St. Paul turned over on her side when she sank at her pier in the Hudson River, New York City. Here she rested so that it was possible for persons to walk about on that part of the sunken vessel projecting above the surface of the water

The vessel was riding high out of the water, her ballast having been removed, which made her difficult to handle. One version of the accident attributes the sinking to an open ash port which, when the ship listed, permitted the water to flow into her hold

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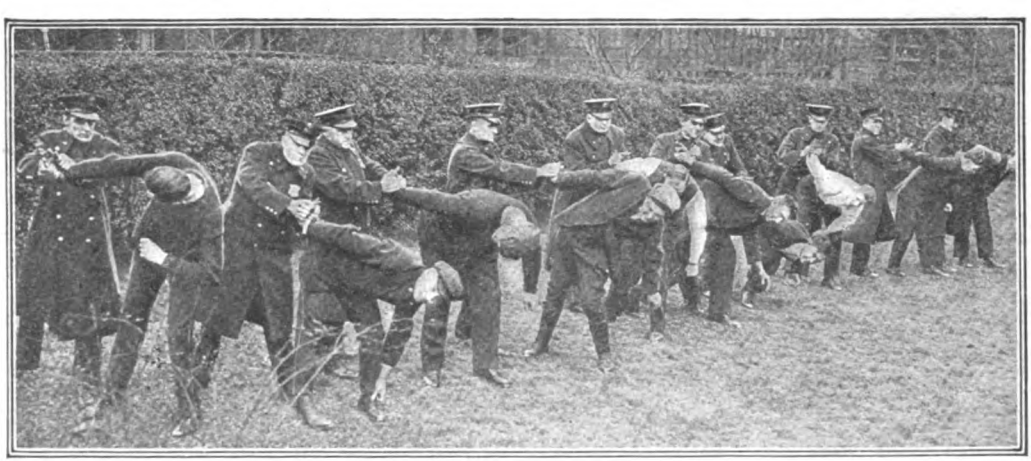
How Philadelphia "Strong-Arm" Policemen Are Trained to Cope with "Criminals and Gangsters Who Resist Them

If the gun is discharged by accident in the struggle for its possession it will hit the gunman

A quick and sharp blow on the wrist with the edge of the hand will make the crook drop his gun

In a rush one may be tripped, another clubbed and the third disabled by the "strong-arm" officer of the law



A class of policemen practising hammer lock, wrist hoist and disarming methods in the open field. They are also taught the armhold on refractory prisoners or other malefactors

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The Policemen Are Given a Regular Practical Course in Jiu Jitsu of a Modified Form by Competent Instructors in the Art

Bending the wrist in this fashion forces the criminal to open his hand and drop his knife

This method of throwing the attacking criminal over the shoulder looks easier than it is

If the push under the chin is hard enough it may break the gangster's neck

Practising the gentle art of twisting the refractory criminal's arm behind his back and locking them there until he becomes reasonable and tractable makes them experts in time

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Charming the Snake in the Occident and the Orient

Photos © Brown and Dawson

This is a snake charmer of Trinidad, caught by the camera man in a typical, natural pose

The West Indian snake charmer visits the gardens of hotels and entertains tourists with performances by his wriggling protegés

These Hindu snake charmers are compelling reptiles to dance in front of a hotel in Lucknow, India, to the music of a flute which can be seen in the hands of one of the men in the photograph

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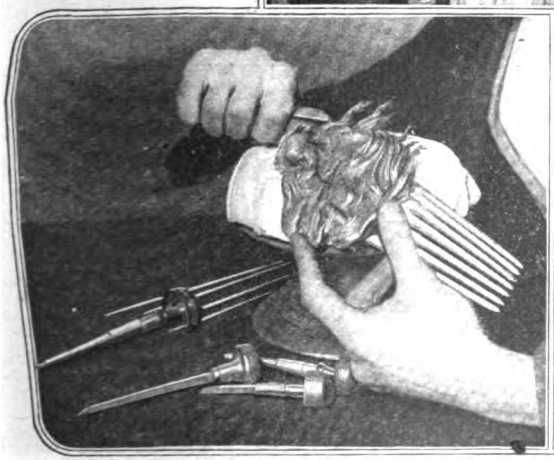
Refashioning Gold, Silver and Brass into Things of Great Beauty and Utility

To shape this bowl, the metal craftsman, Ladislas Emeric Zental, shown in the picture, had to hammer the heated metal for many hours on the small anvil before him

To make this enameled cigaret case the artist first makes the design on the case. Then he applies the enamel in paste form and fuses it into place

The metal is being heated by the flame of a gas blast in order to make it soft so that it can be worked into shape. The shaping is done by hammering



Working on a carved group, "The Lovers," forming the top of an ivory and silver comb of great beauty. The artist rests his work upon a sand-filled cushion block

In chasing designs upon metal the artist places the object he is working on upon a sealing wax block which gives just the right backing, firm but not too rigid

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War Efficiency in France Makes the Most of

The Lyric Theater, Verdun, is a junk shop where discarded articles of wearing apparel are accumulated to be patched into shape again

French Official Photos

The most efficient care is constantly taken in repairing bridles, collars and other parts of a harness

Coats made of sheepskins are being worn by soldiers in the trenches. These men are sorting sheepskins for shipment

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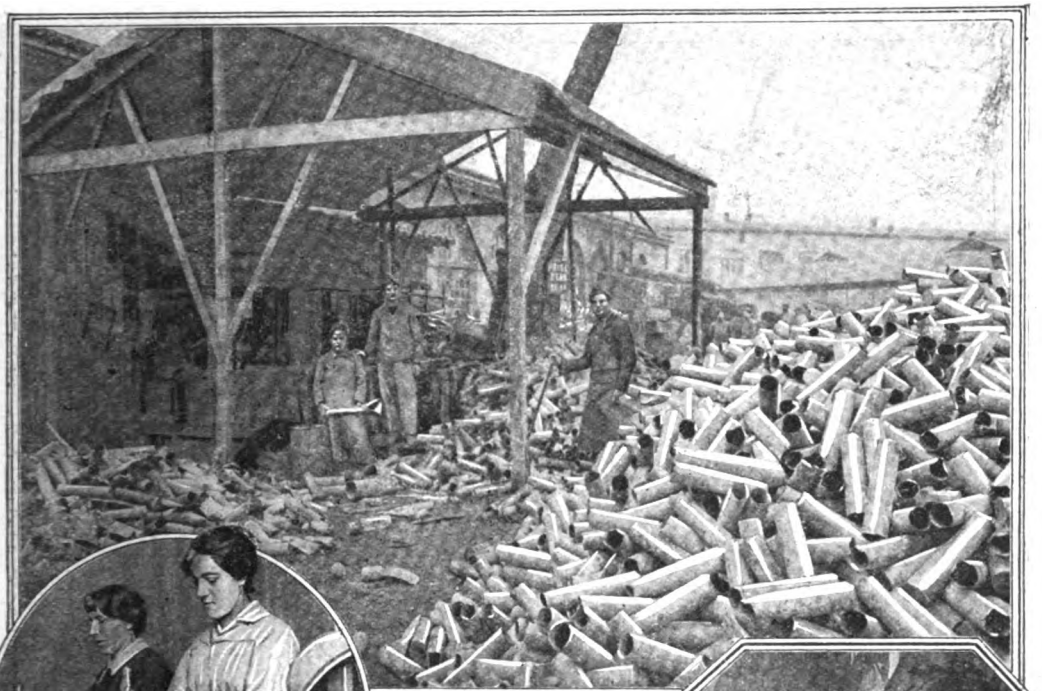
Every Waste—from Shoes to Shell Cases



Damaged shells are sent to repair shops behind the firing lines and then to munition factories for reloading and recapping

Trench helmets, damaged by long use in the rough life of the soldier so as to seem almost beyond repair, are made over again by the patriotic, willing women workers

Even the soldiers' kitchen ware has not escaped the wave of economy. Old women work energetically to mend mess pots and pans

No opportunity is lost to utilize old clothes for making caps for the fighting men at the front

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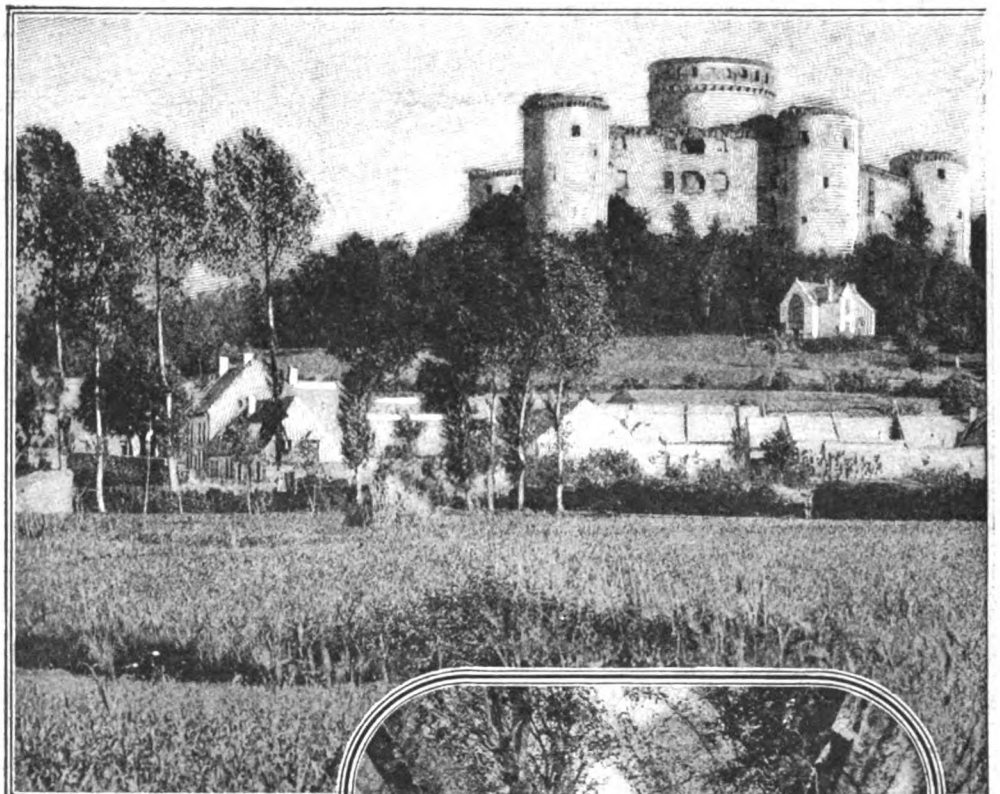
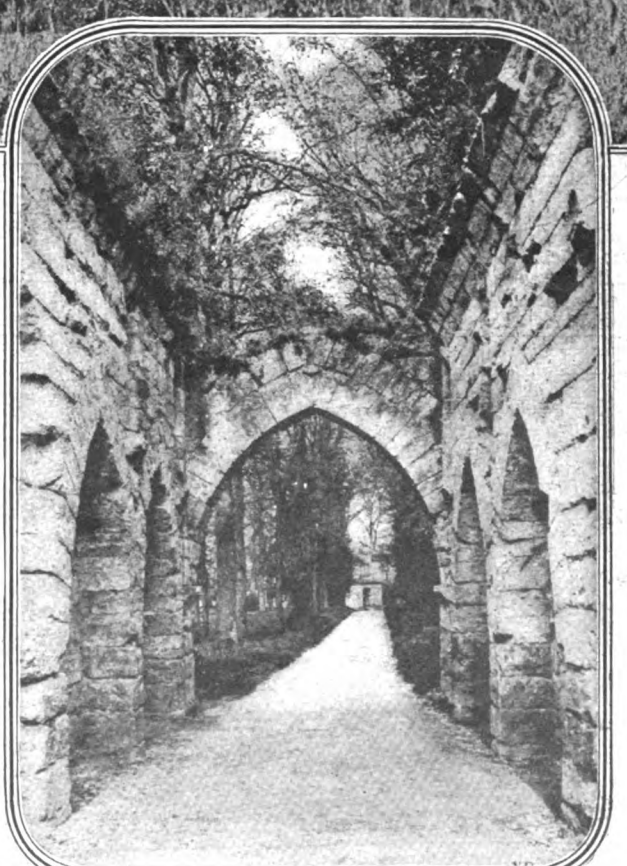
Before and After Von Hindenburg Visited the



A glimpse of the chateau de Coucy, in the Aisne region, a few miles from Laon, France, before Von Hindenburg began his famous "strategic" retreat in 1917



In this view of a tree-covered walk taken from the castle there is no hint of the devastation to come, nor of the vengeance that the invader can wreak. But cast your eye, now, on the next page and see what dynamite and ruthlessness can do to ruin works of art

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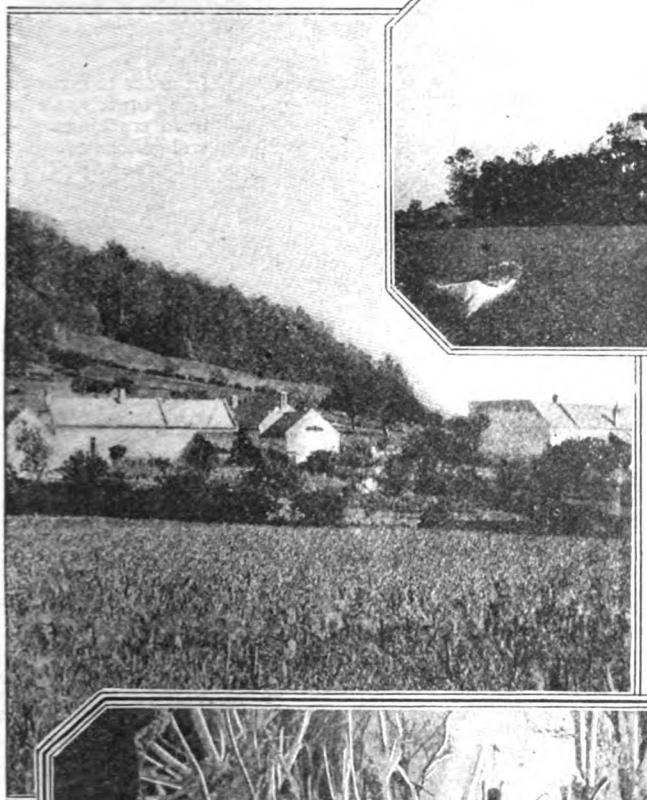
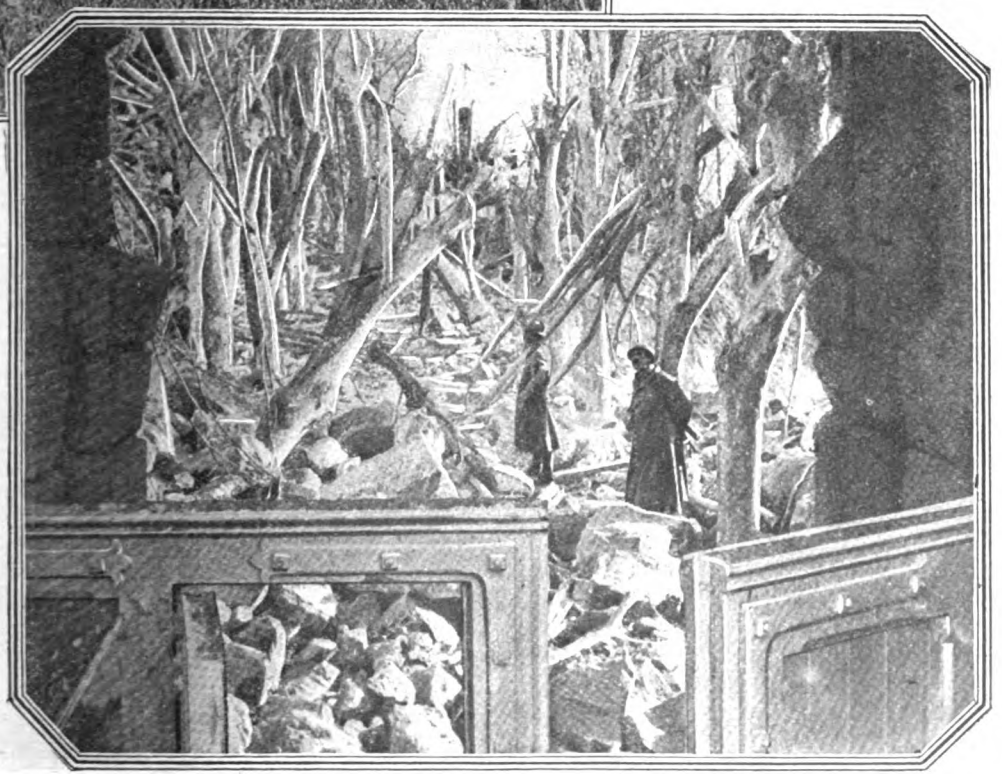
Chateau de Coucy During His Retreat



This is the way that Coucy looked after the forces of Von Hindenburg had completed their work of destruction—sacking, looting and burning

French Official Photos



How the same walk photographed from the same place, shown on the opposite page, appeared after the Germans had left Coucy. It took them only a few hours to effect this transformation. It is a fair sample of German frightfulness

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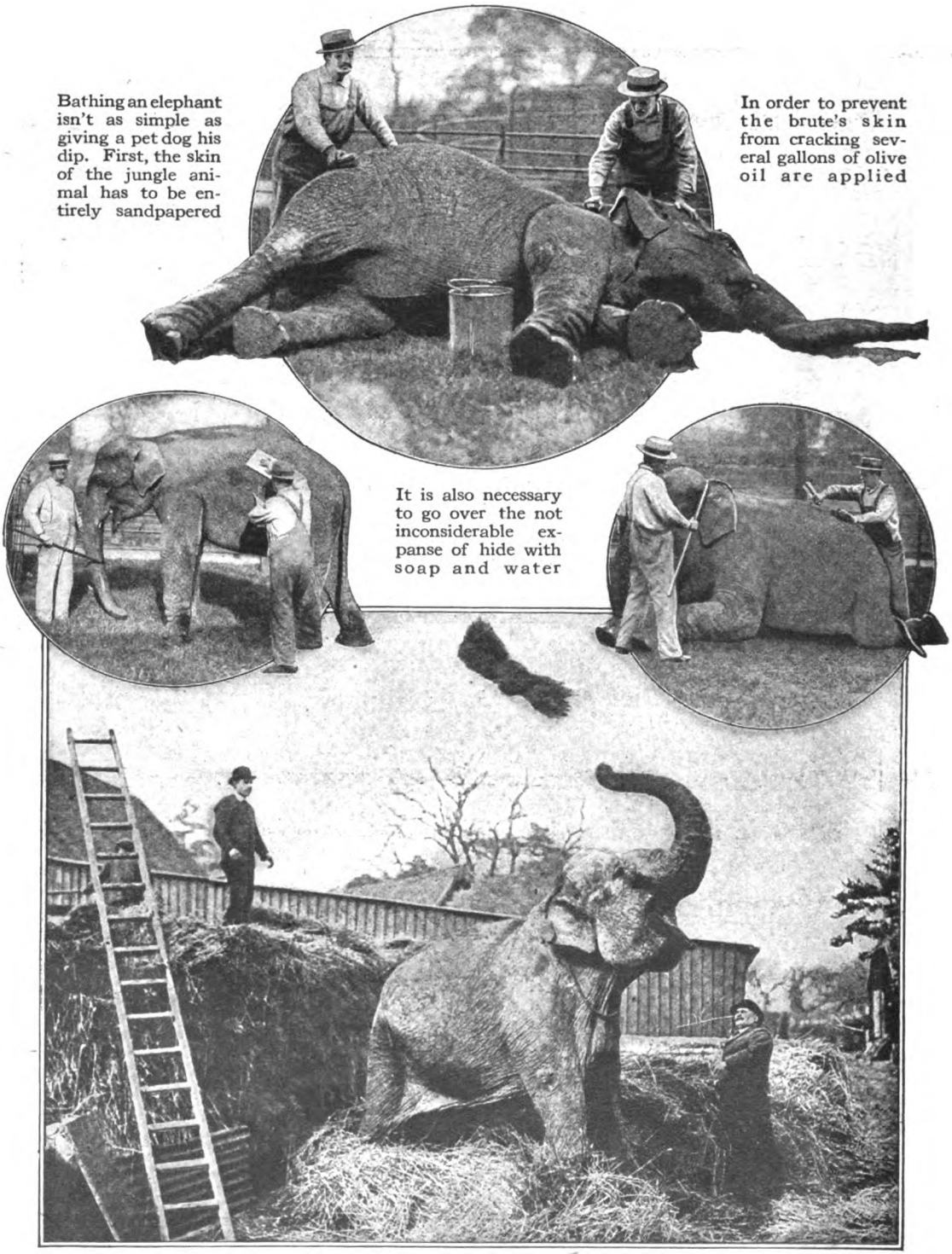
"The Elephant Hath Joints, but None for Courtesy;



Bathing an elephant isn't as simple as giving a pet dog his dip. First, the skin of the jungle animal has to be entirely sandpapered

In order to prevent the brute's skin from cracking several gallons of olive oil are applied

It is also necessary to go over the not inconsiderable expanse of hide with soap and water

The elephant is not only taking the place of the horse on the farm in England, but is becoming a farmer too. This elephant has been taught to pitch hay

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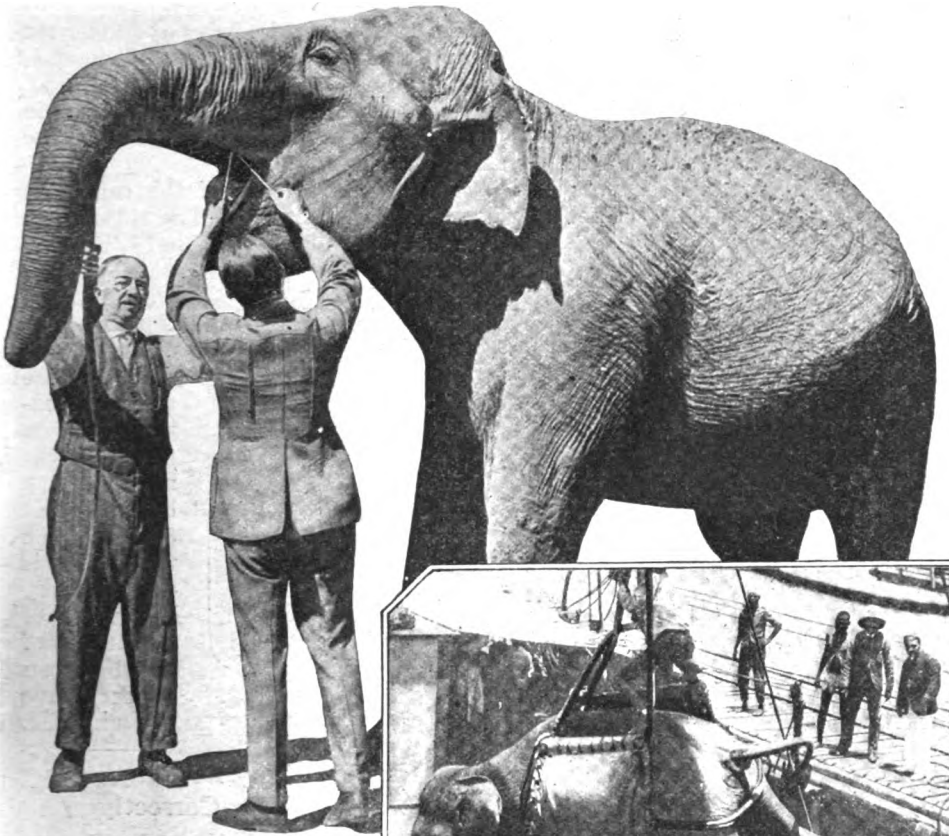
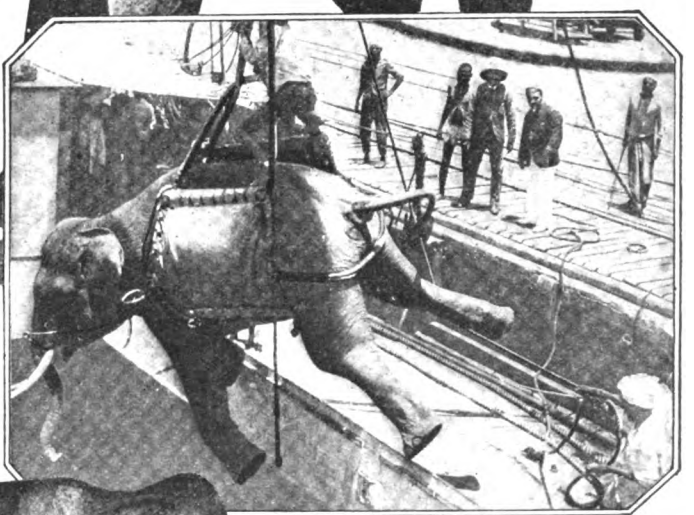
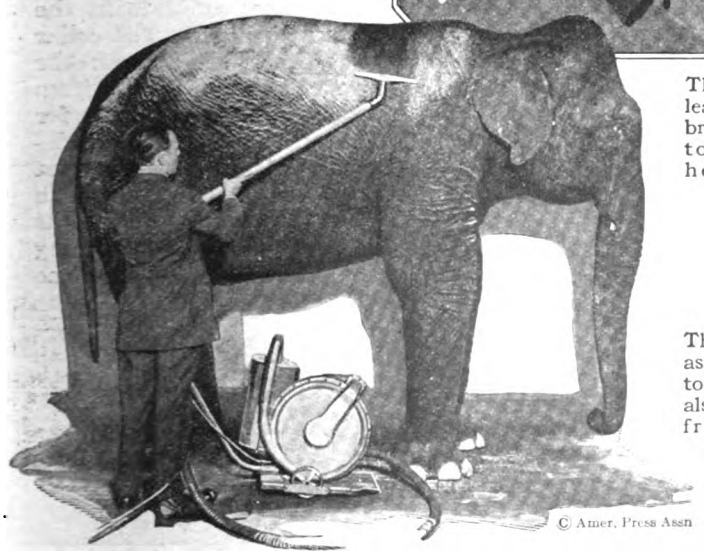
His Legs Are Legs for Necessity, Not for Flexure'



Maude, of the Atlanta, Ga., zoo, had a tooth pulled without even taking gas. But she cried when the operation was over



This elephant didn't want to leave its jungle home, so a breeches buoy was employed to lower it into a ship's hold at Rangoon, Burma



The vacuum cleaner, regarded as belonging almost exclusively to the household equipment, is also used to remove dust from the elephant's hide

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A Cage for Photographing Growing Wild Flowers

THE photographing of wild flowers after they are picked is at best only fairly successful. Wild flowers are inclined to wilt quickly. The finest results are obtained by time exposure; but probably no other class of subjects is so difficult to photograph. There is almost always some vagrant wind to prevent a good time exposure.

To obviate the trouble caused by wind, the "cage" shown in the accompanying illustration was devised and used by the State Botanist of New York. With it nearly four hundred successful photographs of wild flowers were obtained in less than one year.

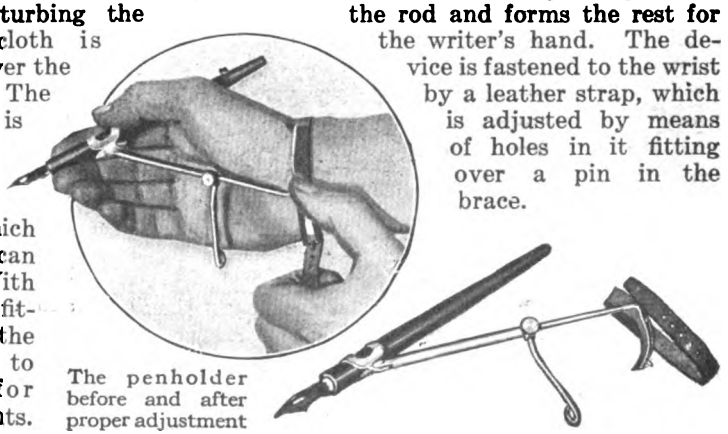
This portable cage will enable you to photograph flowers as they grow—without interference from winds

The sides and top of the cage are made of a transparent cellulose compound. The back is made of light wood before which any tint of cardboard may be placed as a background for the flowers. The front consists of an open frame around which a piece of black oilcloth is tacked. This oilcloth has a small opening beneath so that adjustments of the camera lens may be made without disturbing the apparatus. The oilcloth is made to funnel down over the front of the camera. The bottom of the cage is made of tough cardboard (or light wood) and provided with an opening through which the stems of the plants can pass into the cage. With wooden extension legs fitted to the bottom of the frame it can be raised to any height needed for photographing tall plants. When used in this way a good-sized stone placed inside the cage will keep it from trembling, even in a strong wind. In bright sunlight a piece of white muslin pinned over the device will soften the strong shadows.

The back and front of the cage fold down over the bottom. The sides come off separately, and when folded upon the other parts, with the wooden extension legs make a package about 3 by 2 feet and 5 inches thick. This is easy to carry by means of a couple of small woven trunk straps and a handle.

How Children May Be Taught to Hold the Pen Correctly

A SIMPLE device has been patented by William J. Henry, of Akron, Ohio, to train children to write properly. The pen is held in a clamp which is hinged to the end of a short metal tube having a sliding extension which may be set by the tightening of a set screw to fit the device to any size of hand. The collar bearing the set screw also carries the brace which extends at right angle from the rod and forms the rest for the writer's hand. The device is fastened to the wrist by a leather strap, which is adjusted by means of holes in it fitting over a pin in the brace.



The penholder before and after proper adjustment

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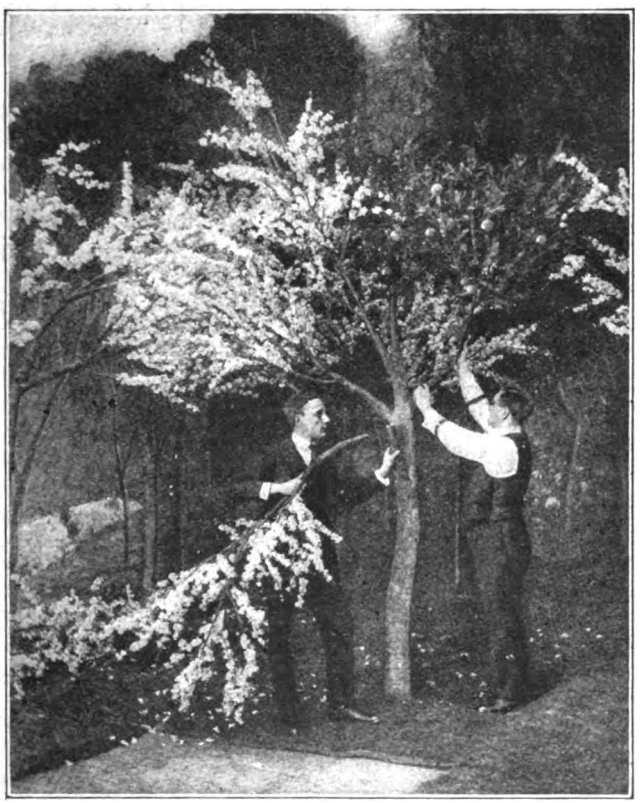
How the "Smileage" Shows Travel

Collapsible scenery and improved "properties" solve the problem of transportation cost

By A. M. Jungmann

THE war has taught us that "It can't be done" is a sentence which we may as well leave out of our language. This is exemplified in the manner in which the scenery for the Smileage plays is handled. Take "Turn to the Right." Before that became a Smilage Play, a baggage car sixty feet in length was required to accommodate the scenic equipment when the play was on the road. Persons who have seen this play will remember that the scenery included a farm and cottage, a peach orchard, a pawnbroker's shop, a kitchen, a well, and an automobile in action.



The peach tree in the successful Broadway production, "Turn to the Right"—blooming in Act II, laden with fruit in Act III

Now the scenery for the prologue and the three acts of the play has been so arranged that it can be packed into bags and trunks and hauled by army trucks. It is all collapsible. The scenery is made of canvas and the large color masses are made with aniline dye instead of being painted. This is done so that it can be folded without cracking. When the play begins each week's performance at the camps, the canvas must be stretched and tacked on wooden battens and erected into sets. No piece of scenery or batten is more than fourteen feet in length. Each batten and section is numbered so that there is no confusion when a scene is set up. When this play is packed and ready for transportation, the entire peach orchard is put into a portmanteau; the two-story house, twenty-six feet high, is packed snugly into the kitchen cupboard, and the kitchen, with the exception of the old-fashioned pump and crockery, is packed into army trunks. If, before the war, anyone had suggested the possibility of giving a play with collapsible scenery and having that same play up to the Broadway standard, there would have been a general chorus from theatrical producers, "It can't be done!"

The time is coming soon when all traveling theatrical companies will pack their scenery as they pack their costumes—in bags and boxes, and their properties in trunks, crates and barrels to prevent breakage.

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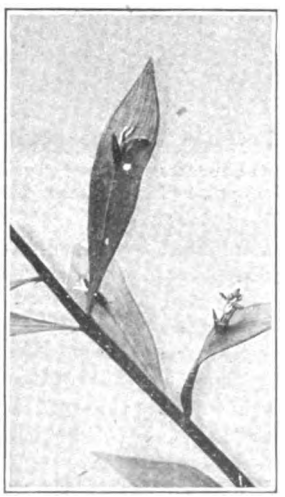
Goldfish are attracted by a flashlight to the surface and dipped up with net without any fuss, splash or splutter

The Flashlight Makes It Easy to Take Goldfish from Pools

TAKING goldfish from a large pool is not an easy problem—particularly if it is to be accomplished without frightening the fish literally to death. Mr. Dwight Warren, one of the residents of Alhambra, who has a Japanese garden, in which is a large pool full of goldfish, has devised a plan by which the fish may be caught so that they may be moved from pool to pool or from pool to globe without the slightest chance of injury.

Mr. Warren handles his fish at night. He uses a small hand net and a pocket flashlight. The fish are attracted to the surface by the light held against the surface of the pool. The instant the light is cast in the water, the fish swim up and nose around the light. The net is then placed under them, and they are lifted out of the water without the slightest trouble, fuss, splutter or splash and transferred to another pool or put into a globe. The fact that fish are attracted by a light at night is too well known to require reiteration. In any case, the experiment is worthy of a trial.



The leaflike organs bearing the flower are not leaves but twigs

Plants with Flowers on Their Leaves

THE hot midsummer's heat in the light, dry woods of southern Europe, where the interesting varieties of butcher's broom (Ruscus) are found, lulls everything into a deep and peaceful sleep and while the other plants look dead the "Ruscus" alone remains green. The shoots of these plants are not round or stalklike, but are, in part, thin elongated surfaces resembling leaves, which are attached to the main stem by rounded stalks similar to the petioles of leaves. Strange as it may seem, these growths are shoots or branches and not leaves. Only in the first stage of the development of the plant, true leaves are found, and these resemble small, pale scales which are attached to the long rounded shoots. Between the scales the leaflike shoots, which the botanist calls phyllodes, soon begin to grow. The scalelike leaves wither and fall after the shoots have developed. The phyllodes then assume the functions of the missing leaves, which they so closely resemble in outward appearance. Otherwise they have the characteristics of ordinary rounded twigs or shoots. Upon the surface of these flattened shoots, scalelike leaflets again make their appearance. Small flowers with short stems thrust themselves between the scales and these, after fertilization, bear seeds, by which the Ruscus may be reproduced.

These peculiar plants are not too common. They are fascinating when they are decked out with small dainty flowers and are of exceeding interest to the botanist and the naturalist. Children over there enjoy gathering them as children in this country enjoy picking the lovely arbutus.—DR. E. BADE.

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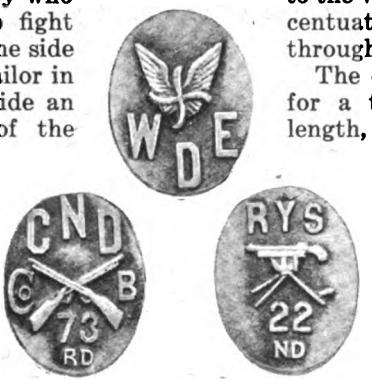
Ornamental Identification Rings for Soldiers and Sailors

A NOVEL finger ring, made of silver or gold, as desired, has been devised as a parting gift for that boy who is going across the sea to fight Uncle Sam's battles. On one side of the ring is a soldier or sailor in relief work, on the other side an eagle. Raised emblems of the fighting man's initials, regiment, and company ornament the top of the signet. Our illustration gives a fair idea of the appropriateness of the designs of these rings. The ring will serve a double purpose, as a keepsake, and a means of identification.



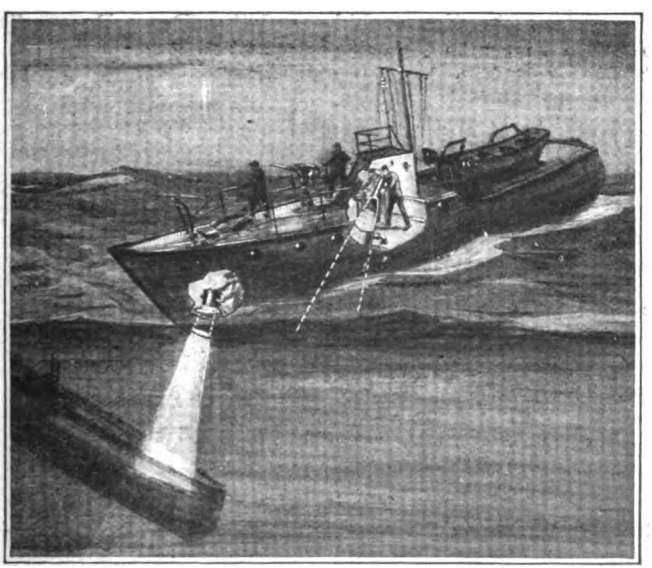
A symbol of friendship and faith for the parting boy in khaki or blue

Finding U-Boats in the Depths of the Sea

"MAN the observing tube and watch sharply," is the command given by the captain of the submarine chaser. In the gloomy light his binocular has shown him a distant periscope and it behooves him to be cautious. Just behind a gun on the forward deck of the submarine chaser an observer takes a position at one end of a viewing tube which intersects the bottom of the vessel and enables him to sight objects under the surface of the water. He is aided by a viewing plate in the tube and a powerful electric searchlight behind lenses in the bottom of the vessel near the bow. The rays of light illuminate the depths of the ocean and reveal even small objects clearly. Valves are arranged to prevent water from entering the vessel and also to keep it in the tube close to the viewing plate in order to accentuate the visibility of objects through the tube.

The observer scans the depths for a time without result. At length, however, he glimpses a submarine many feet below. The submarine is moving slowly and the "chaser" adapts her speed to that of the U-boat. Quickly the chaser's commander gives orders for the release of a depth bomb. Through the tube the observer sees the death-machine drop on its mark. There follows a great disturbance of the waters where the submarine has been. Afterward the lenses reveal only dismembered parts of the submarine.

It is thus that Alexander Egenes of Lower Rochester, Nevada, would combat the submarine menace; for he has invented a submarine chaser which embodies the features unfolded in the foregoing description. But Egenes forgets many things. In the first place, electric lights have no great penetrating power in water. In the second place, the waters of the North Sea and the North Atlantic Ocean are usually so rough that even if the most powerful searchlights could be directed downward, nothing but murkiness could be seen.



Showing the under-water telescope in action provided the searchlight could be made to penetrate the depths

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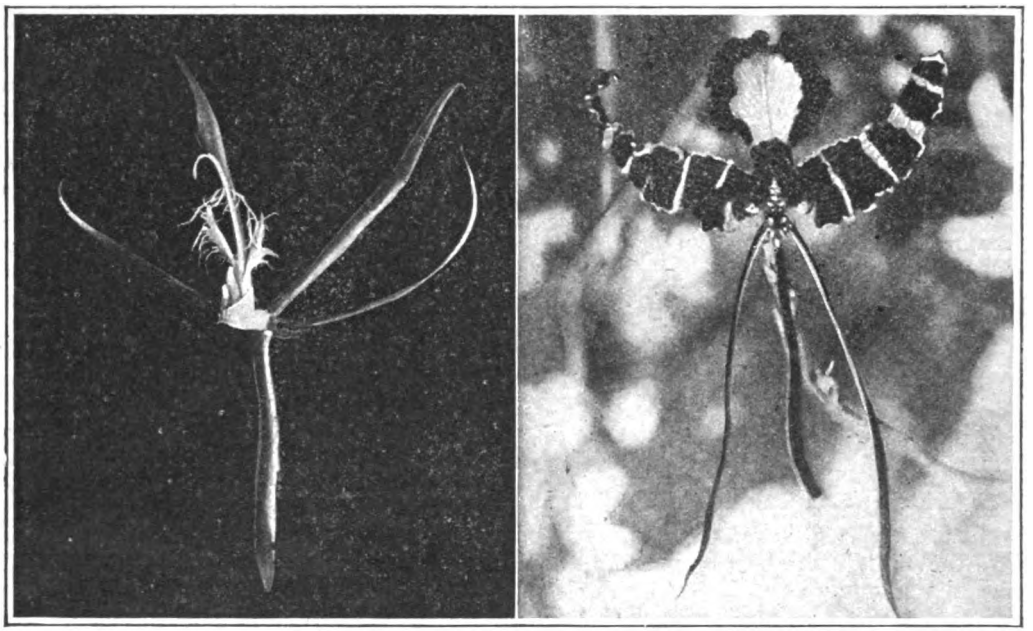
Camouflage in the Wars of Nature

THE two flowers shown in the accompanying illustrations are remarkable instances of natural mimicry, one strikingly resembling a butterfly, the other a spider. Both belong to the orchid family and grow wild in South America and the West Indies. The butterfly orchid is occasionally grown in hothouses in the United States and attracts attention by the beauty of its coloring and the close resemblance of the open flower to a butterfly with striped upper and bordered under wings. Even the long proboscis and the antennae of a butterfly are mimicked. The mimicry of the spider orchid is not so exact, but sufficiently so to justify the name given to its dainty and strange form.

This mimicry is not a freak of Nature. Scientists believe that its object is to protect the species by attracting beneficial influences or by repelling those that militate against its preservation.

The orchid family is highly developed. It comprises more than twelve thousand species, most of which grow wild in the tropical jungles of India and Brazil. Few species are found in the temperate zone. Many of the orchids, especially those growing in the tropics, are noted for their peculiar structure and exquisite beauty of form and coloring. They grow on other plants, but derive their nourishment principally from the air.



The peculiar-shaped orchid shown on the left is named "Spider," which it distantly resembles. The other is called the "Butterfly" orchid and looks exactly like a butterfly

Why Does Paper Turn Yellow With Age?

IT is a well-known fact that paper exposed to light will become yellowish within a comparatively short time; and even when kept in storage where light does not reach it, it will undergo gradual deterioration. Recent investigations by Dr. Klemm have demonstrated that these changes are due mainly to the presence in the paper of mechanical wood-pulp or lignified fiber, although they are met with also in paper colored with dyes that fade under exposure to light. In wood-free papers the fading is found to be due to a formation of soaplike compounds of iron with rosin and fatty substances. The greater the amount of these compounds present, the more marked the yellowing of the paper. A mixture of ether (two parts) and alcohol (one part) will remove the soap-like matter.

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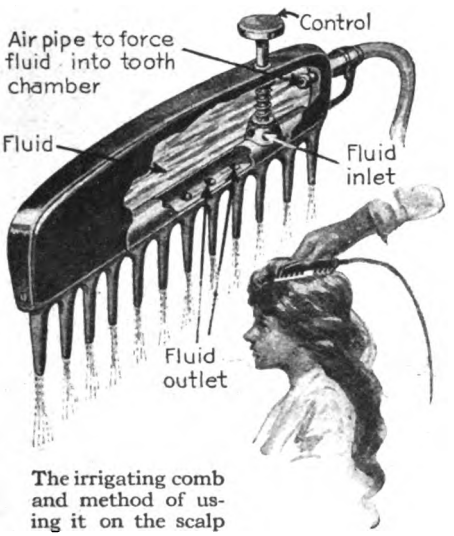
Fountain Comb for the Treatment of the Hair

IN the treatment of hair it is often desirable to reach the parts nearest to the scalp and the scalp itself without coming in contact with the other parts of the hair. The rubbing of ointments and salves into the scalp has always been troublesome and often ineffective because most of the ointment never reached the scalp, but was smeared upon the hair. The well-known fountain comb, recently improved by E. McG. Jones, of Winchester, Ky., is intended to remedy the defects of the old method. It consists of a reservoir for holding the liquid or salve to be applied to the scalp or to the roots of the hair and a device for forcing the contents of the reservoir through the teeth of the comb.



The irrigating comb and method of using it on the scalp

The pressure is supplied by compressed air which is conducted to the reservoir by a flexible tube. The reservoir does not connect directly with the teeth. To reach the teeth the liquid in the reservoir must pass through an opening into a tube from which channels lead to the teeth. The opening to that tube is controlled by a valve operated by a push button from the top of the contrivance.

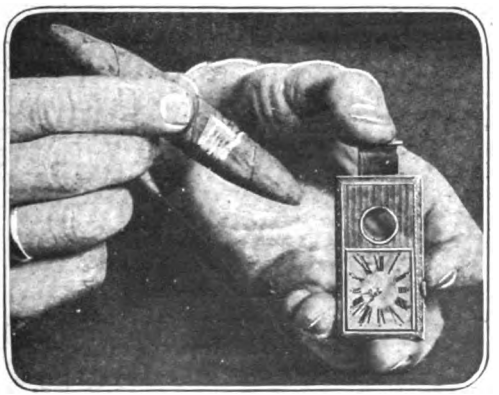
The illustration on the top shows clearly how this fountain comb is operated. The operator holds it in his right hand and presses the button when he wants the salve or ointment to go into the tube from which it flows down the teeth of the comb.

The Cost of Enrolling a Soldier in Uncle Sam's Army

FIGURES compiled from the records of the first draft show that it cost the Government almost exactly five dollars for each man drafted. All but seven cents of this amount represents the expense of the draft boards. In comparison with this, it is interesting to learn that the volunteer system of recruiting cost $24.48 per man in 1914; $19.14 in 1915; and $28.95 between July, 1916, and April, 1917. These latter figures, however, included the recruit's traveling expenses and the cost of his subsistence prior to acceptance.

Time for a Smoke? Take Out Your Combined Watch and Cigar Cutter

COMBINATION tools and combination appliances have been invented in large numbers and with varying degrees of regard for the fitness of the combinations. Here is a new combination, recently invented and rather original. It is difficult to decide whether it is a watch combined with a cigar-cutter or a cigar-cutter combined with a timepiece. The inventor has undoubtedly conferred a great boon upon the class of methodical smokers who regulate their "smokes" in accordance with the time. By looking upon the watch they can tell at a glance that it is time for another cigar—no matter whether the watch goes or not. The cutter is always ready.


The time-keeping cigar-cutter and how it works by thumb pressure

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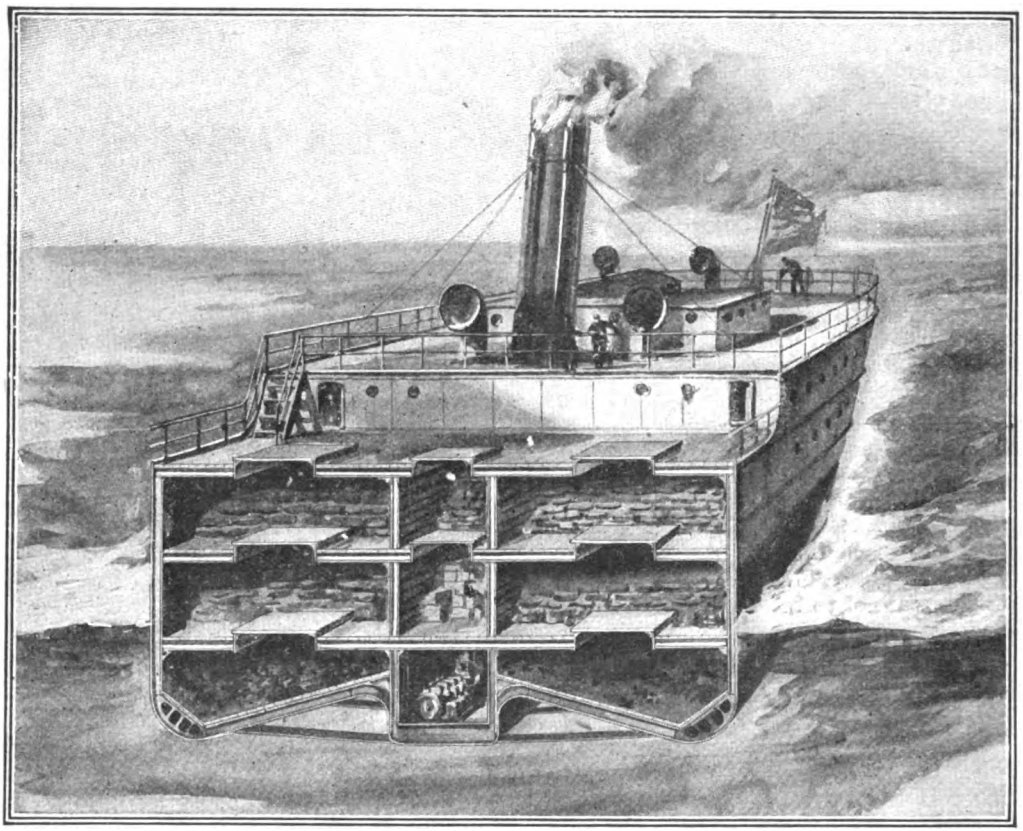
Let the Torpedo Go Under the Ship

Shallow-draft ships to foil the submarine

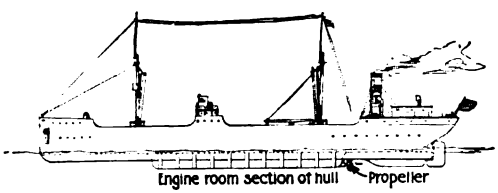
By Joseph Brinker



This cross-section through one of the proposed shallow-draft torpedo-proof ships shows the concave bottom and the tub-like compartment in which the engines are installed

TORPEDOES are set to travel a depth of ten to fifteen feet. Hence it has been suggested that the submarine problem can be solved by constructing 3000-ton ships which draw only five feet of water, except in a limited portion of the hull which has a draft of eight feet.

The shallow draft has been made possible by increasing the beam or width of such a vessel to about sixty feet as compared with thirty-five feet on ordinary ships of the same tonnage. The new type of ship has a concave or hollow bottom. When going at full speed the ship will have a tendency to "plane" or glide over the surface of the water, somewhat like a fast racing motor-boat. Because of its great beam, the distribution of the cargo space is greatly simplified. Oil engines are to be placed in a tub-like compartment which extends three feet below the bottom line. This gives a total loaded draft of eight feet, which is about one-half



Diagrammatic side view of one of the torpedo-proof steamships. Note the engine-room section and the propeller behind

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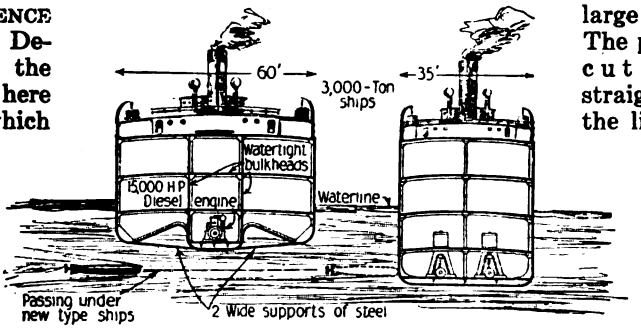
that of the ordinary ship. It is this large reduction in the draft that is supposed to make the ship torpedo-proof.

While the location of the engines in a tub-like appendage is not new (it was illustrated in a small thirty-foot boat described in the POPULAR SCIENCE MONTHLY of December, 1917), the design shown here is the first in which the principle has been applied to large cargo-carrying ships for ocean travel. The hull enclosing the engines is braced to the sides of the concave hull proper by means of two-foot plates of steel, placed about ten to fifteen feet apart. These plates will tend to assist in the gliding or "planing" of the ship when it is going at high speed.

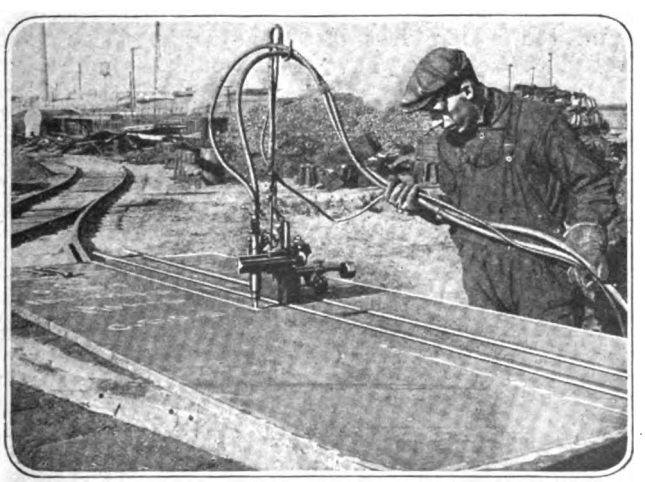


The torpedo will pass under the shallow draft-ship, but will strike the ship of conventional type and deep draft

The engine compartment is separated from the rest of the hull by water-tight bulkheads. The inventor claims that, even if the engine compartment should be struck and destroyed by a torpedo, the water would not rush into the hold of the ship. He thinks that the 1500 horsepower oil engines would be capable of giving to the ship a speed of thirty-two to thirty-eight miles an hour, but this estimate is undoubtedly too high. Such a speed would enable the ship to run away from any submarine built up to the present time. But even if the ship's speed should be less its shallow draft would enable it to dodge a submarine's torpedoes.

An Oxy-Acetylene Cutter That Runs On a Railroad Track

THE illustration shows an interesting application of an oxy-acetylene cutter, which is used at one of the great mills for cutting large steel plates. The plates must be cut perfectly straight. To follow the line by hand is tedious and unsatisfactory because it is invariably more or less inaccurate. Accordingly, the idea was conceived of mounting the blowpipe nozzle on a wheeled stand, and using an electric motor to move it backwards and forwards along a miniature railroad track, which is laid on the metal slab to be cut. The line along which the slab is to be cut is first chalked out, and then the track, which is all in one piece, is laid down parallel to it with a gage. The machine is placed on the track, and the operator controls both motor and gas pressure by suitable mechanism. He starts up the motor and the machine runs slowly along the rails, cutting the slab precisely along the line. The time saved by this new method is considerable, and the precision attained is much greater than by the hand method. Moreover, this machine is easily operated by one man, who need not be a skilled mechanic. In fact, any man with common sense can run it successfully.



With this device and the miniature track heavy steel plate can be cut with rapidity and absolute accuracy

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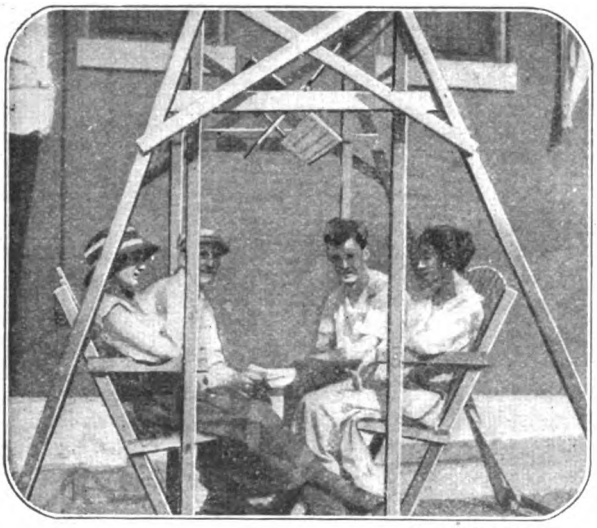
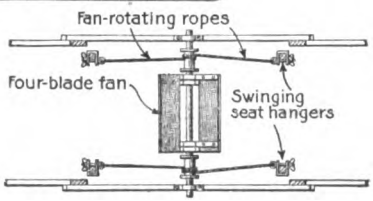


A lawn swing equipped with cooling, revolving fan



To the left—mechanism that makes the fan rotate

Compelling the Lawn Swing to Work a Fan

IS it impossible for you to "get a breath of air? Is the house stuffy? Are even the moving-picture theaters languid from the humid heat? Can you not find a refuge from the sweltering heat even in the cellar?

Well, try this and be cool. If you have a lawn swing and ten square feet of ground on which to place it, you may have a breeze, no matter if you are sandwiched in between six-story apartments.

Here's the way. A Missouri inventor recently has perfected an automatic fan for lawn swings, which the "back and forth" motion actuates and controls. As you and your girl sit facing each other, you have only to push gently on the footboard. The swing moves slowly to and fro, causing the fan overhead to revolve steadily, sending down a pleasant cooling breeze.

The fan, a four-blader, can be bought cheaply. It is constructed to fit any lawn swing. A man can adjust it in five minutes.

The inventor of this device may be assured the gratitude of suffering humanity. Unless courting becomes a thing of the past, youths and maidens this coming summer will rise up and call him blessed; unless they prefer to do so sitting down, as they swing back and forth in comfort.

A Boat Landing That Is Adjustable

A BOAT landing which can be adjusted to various water levels has been invented by William C. Ross, of Columbia, Ohio. In principle it does not differ materially from the Morris chair. The landing consists of a platform, a prop, and a supporting member which takes the place of the usual wooden piles. Both the platform and the supporting member have holes so that they can be raised or lowered to meet the different tidal conditions. However, it is necessary only to remove the pin which holds the landing to the supporting member in order to adjust it. With a heavy landing, this would necessitate considerable work. Should it be desired to adjust the landing several feet at a time, it might become necessary to remove the pin from the prop as well. The ordinary floating landing now in use would seem to offer advantages over the one described here.

But doubtless the inventor is able to demonstrate wherein this product of his inventive genius is superior.

The landing can be raised or lowered by removing either one or two pins

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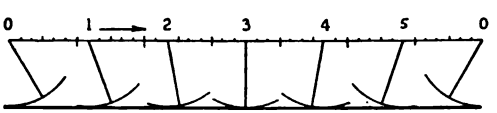
The Rocking-chair Crutch and Why Cripples Should Use It

DR. ROBERT G. HALL, of Portland, Ore., has devised a new type of crutch based upon sound mechanical principles and extremely simple in construction. In his preliminary report to the American Medical Association, Dr. Hall points out:

"The present form of crutch, with only slight modifications, has been used since antiquity. At least no change on the mechanical principles involved has been made. When a step is taken, the tip is at a fixed position on the ground, and the crutch, as a radius, revolves about it. As a result the shoulder follows the form of an arc, first rising and then falling with each step. Thus, for a man using a 55-inch crutch, if his weight is 180 pounds and he takes a 2½ foot step, he will rise and fall two inches, which means that 30 foot pounds of energy are wasted at each crutch step."

In descending hills, the downward rolling motion is retarded by the rear handle-extension

In devising his rolling crutch, Dr. Hall reproduced in metal the shoulder curve of the crutch and applied this metal arc in the form of a rocker to the base of the crutch. When such a crutch is used the shoulder end travels in a straight line. The jerky, up-and-down hobbles o characteristic of the old crutch is changed by this device into smooth, wheel-like forward motion. The diagram shows the successive stages of this wheel-like progress clearly.



This diagram shows seven consecutive phases in the rolling crutch's motion

The originator of this device admits that the rolling crutches are cumbersome and apt to get in the way of other people, that they are heavier, more expensive and more complicated than the old crutches; but that they also have many advantages of fundamental importance. They mean a saving of strength and energy; they lengthen the step without additional effort, give better support and steadiness to the body and lessen the jar to the human system considerably.

Dr. Hall has devised rolling crutches with rockers 14½ inches long and folding crutches with rockers 31 inches long which, when folded, are only 12 inches long. The crutch with 14½ inch rockers is probably the most practical, as it is less cumbersome and awkward to handle than the one with longer rockers. The addition of an extension to the handle of the crutch is of advantage. By its use in front or in the rear of the crutch the rolling motion may be changed to a rolling-up or a rolling-down motion which is helpful in walking uphill or downhill.

Studying History at First-Hand

LIGHT travels at the rate of 186,000 miles per second. As everyone knows, we are now looking at some stars with lights that left them centuries ago.

Suppose that you could be shot into space at a velocity greater than that of light. And suppose that you were armed with a telescope so powerful that you could see everything that happened on this earth. A time would come when history would unfold itself before your astonished eyes. You would see Napoleon losing the Battle of Waterloo; you would see Benjamin Franklin and all the other signers of the Declaration of Independence vowing that they would be hanged rather than endure British oppression any longer; you would see the surrender at Yorktown, the Battle of New Orleans, and the naval fight off Santiago; you would see the death of Julius Caesar, and then Mark Antony making love to Cleopatra on the Nile. If you like, you could juggle yourself back and forth so that you could see the same event over and over again and make a special study of it.

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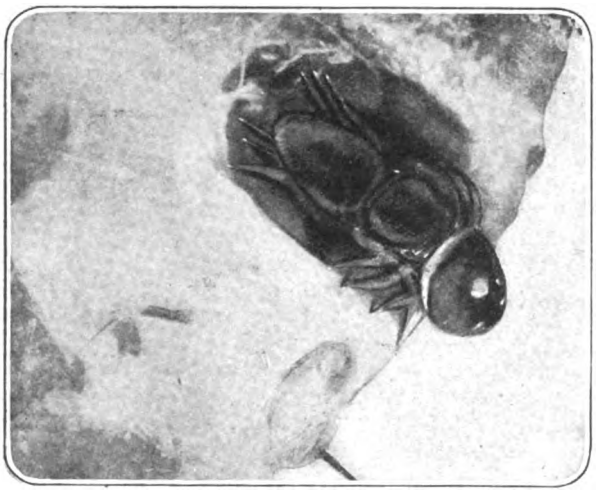


A specimen of the ugly, poisonous spider (Cactus Tarantula) that infests cactus jungles in Texas

How to Avoid the Spontaneous Combustion of Coal

UNLESS coal piles are well ventilated spontaneous combustion will follow. To prevent spontaneous combustion, the Bureau of Mines gives these suggestions: (1) Build a coal pile on dry ground. (2) Store only one size of coal in each pile. (3) Remove fine coal for immediate use if possible. (4) Don't wet and dry the coal alternately while piling. (5) Store the coal in small piles near the place where it is to be used. (6) Use small bins in storage yards.

Beware of This Horror of the Cactus Jungle

THERE are many pleasanter places than the cactus jungles which are found in different parts of southern Texas. Luther Burbank has produced a spineless cactus, but that isn't the kind that grows in these jungles. Besides the large assortment of perfectly good and efficient "stickers" of which the Texas cactus jungles can boast, an incredible large variety of living creatures, apparently created for the special purpose of making these jungles more interesting to unsuspecting travelers, may be found in these localities.

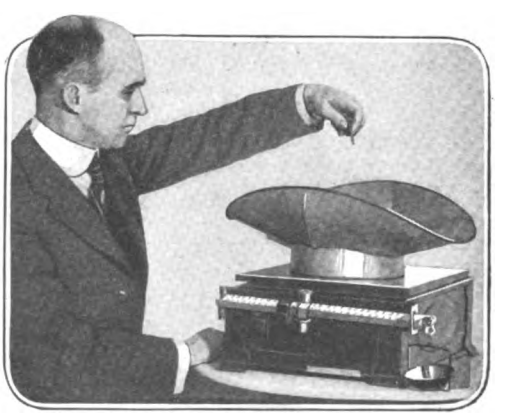
One of these denizens of the jungle is shown in the picture—a very difficult photograph to make, for which we are indebted to Dr. H. Menger of San Antonio, Texas. It is a large variety of the Cactus Tarantula, a vicious and poisonous jumping spider, which, in the illustration, is seen lurking at the upper entrance to its silky white breeding nest. This nest, woven by the big spider, extends to the left of the picture and covers part of the cactus leaf. The spider usually builds its nest between two cactus leaves close together, to be protected against the cactus wren and other insectivorous birds.

These spiders are powerful, fierce, and excellent jumpers. Their food consists of insects. All of them are more or less poisonous.

If You're Weak in Arithmetic Let This Device Do the Work

A DEVICE designed for accurately reckoning the number of small articles has a quantity scoop on top of the apparatus and a ratio scoop at the end of a scale. In order to make the scale balance, each unit placed in the ratio scoop calls for fifty times as many in the quantity scoop. There is so little variation in the weight of small articles, however, that, to insure accuracy, more than a single unit should be placed in the ratio scoop.

This scale can also be used to compute the postage for parcels and the rates according to zones, being graduated to read in eighths of an ounce.



A scale to count articles and determine postage for parcels according to zones

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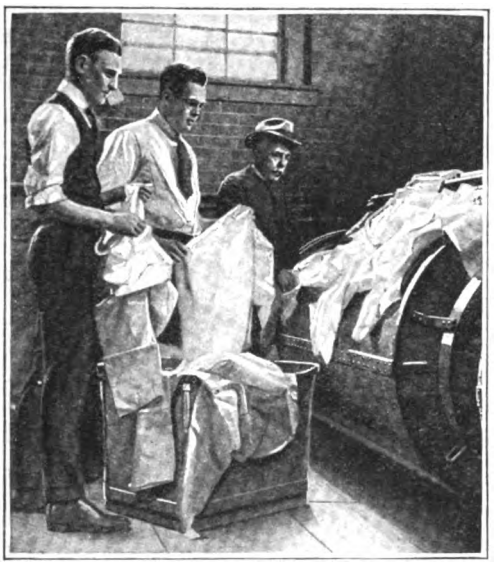
Making the Soldiers' Undergarments Proof Against Vermin

THE chemistry department of the State University of Iowa is taking the initiative in making underclothing vermin-proof for use by American soldiers in France. Undergarments made by Red Cross groups, or relatives and friends of the soldiers, are sent to Iowa City, where they are treated to withstand "trench lice." The clothes are put into a laundry washer which contains a mixture composed of sulphur and naphthalene dissolved in gasoline. Twelve thousand pieces have already been treated, students of the chemistry department doing the chemical work and the women of the domestic science school attending to the packing and shipping of the garments.



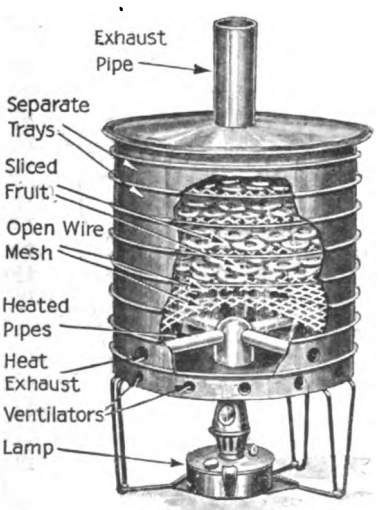
Treating clothes so that they will be vermin-proof—an American chemical discovery

Sanitary, vermin-proof clothing insures comfort as well as health, as "trench lice" are known to be carriers of disease germs, especially of typhus.

A Kerosene Lamp for Fruit Drying

THE lack of suitable apparatus for evaporating fruit and vegetables for preservation has been felt keenly in many rural communities where neither gas nor electricity is available. A simple and thoroughly sanitary evaporator for fruit and vegetables, in which a kerosene lamp supplies the required heat, has recently been placed in the market and should prove practical for farmers and housekeepers in small villages.

The device consists of a stack of seamless pans with wire-net bottoms and a heater underneath them. The pans have a diameter of eighteen inches, and six of them are provided, affording a drying surface of nearly ten square feet. This gives a capacity of three to four bushels of apples per day and a proportionate capacity for drying other fruits or vegetables. The heater is so made that the direct draft from the lamp goes through the heater only and does not enter the evaporating trays. The fruit cannot absorb the odor of the burning oil of the lamp.



This evaporator is operated by an ordinary kerosene lamp

Making Cannon Powder Explode Gradually in the Barrel

A propellant explosive, such as is used to propel a shell from a cannon, has its rate of explosion controlled to a certain extent by varying the chemical composition and the size and shape of the grains of powder composing the charge, so as to be consumed gradually. It is essential that the explosion of the powder occupy the same space of time that it takes the shell to pass through the bore of the gun, in order to utilize in full the propelling force of the charge. In a small-bore gun this occupies about one-fifth of a second. This is true of the 3-inch gun.

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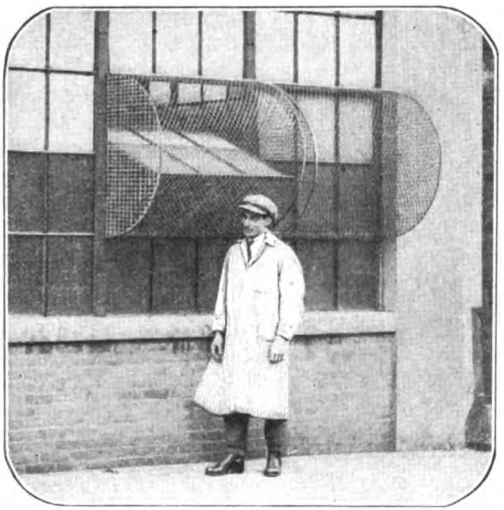

Wire screens placed around the open window sash prevent injury to the passer-by

Passers-by Are Protected from this Open Factory Window

A MAN passing close to a factory wall, where one of those outward slanting windows happens to be open, might sustain a serious injury by knocking his head against it. An automobile plant in Detroit has recently attached wire guards to its lower windows, so that, when they are open, adequate protection will be afforded against just such accidents. Our illustration shows how these guards are adjusted.

Aviators, Electrically-Clad, Defy the Cold

B-R-R-R! It was cold—so cold that the watch of a sentry in the Allies' camp had stopped. He pointed commiseratingly at the aviator who was soaring aloft in the driving snow storm.

"That fellow's going to suffer more than we are," he remarked to a companion, "going way up among the clouds."

The sentry's sympathy did not seem out of place in view of the fact that at high altitudes (8,000 to 20,000 feet) the temperatures are freezing, even in midsummer, and that some aviators who fight at 20,000 feet are as cold as the men who reach the North Pole. But, as a matter of fact, the airman was probably much more comfortable than the soldiers on the ground below him. For he was snugly clothed in an electrically-heated garment. Electrically-heated shoes kept his feet warm, and he wore an electrically-heated hood and gloves.

The garment was provided with three circuits or coils wrapped in the fabric of the cloth. They encircled his body. These circuits, which were parallel with one another, were distributed so that all parts of the garment were heated when they were connected up, a corresponding warmth being produced in the shoes, hood and gloves. The windings extended through a switch mounted on a thermostat made to expand under heat. In the insoles for his shoes as well as in the gloves and hood were wires connected with the windings of the garment. Current from a storage battery was supplied by adjusting a contact screw.

After a time the temperature of the garment rose to such a point that the thermostat began to expand. This operated the switch and as a result the contact point of one of the coils in the garment was drawn away from a contact point connected with the main circuit, cutting off the current. Further expansion of the thermostat cut off the circuit of another coil in the same way, and as the temperature continued to increase the heating power of the third winding was taken away. Then the temperature of the garment began to lower again, permitting the circuits to be reconnected. Thus the temperature of the cold dispeller was automatically regulated. The thermostat mechanism was enclosed in a casing and placed where the temperature of the garment caused it to operate.

Clothed in this suit, the aviator has no fear of extreme cold

So, you see, the sentry's sympathy was wasted. As a matter of fact, every aviator is clad to resist cold.

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The Armored Flying "Tank"

When Lufberry was killed battling with a German armored flying machine a new epoch in aviation dawned

By Waldemar Kaempffert and Carl Dienstbach

Our grandchildren will thrill to the story of Raoul Lufberry's bravery. He will go down in history as the man who died in fighting the first armored flying machine

From the paint'ng by Lieut. Farré

OVER the American sector, north of Toul, a German biplane appears —a giant with three cars. In the central car sit a pilot and two observers; in the side cars are the powerful engines. Such huge, cumbersome machines are usually employed for bombing—rarely for combat. What an easy mark! Immediately two Americans start up, followed by two others. At twelve thousand feet they recognize the German for what he is—a huge Friedrichshafen or Gotha. They rush for him and pour in bullets. Nothing happens. The bullets rattle off. The German proceeds stolidly on his way.

Then Lufberry, the American "ace," leaps into the air. In his fast *avion de chasse* he overtops the German. He plunges down and fires as he dives. Again and again he turns, climbs and rains in bullets. The machine guns manned by the two fighters in the German machine vomit flame and lead. Suddenly Lufberry is seen to lurch. Smoke shoots up from his machine. He plunges. There can be but one terrible end—death by fire or death by a sickening fall. Lufberry unbelts himself, rises, and leaps from his machine. A bruised, almost unrecognizable mass is picked up in a flower garden. Thus the most famous American "ace" meets a Homeric end fighting the first steel-clad battle-airplane.

Why the Gothas Were Built

Now the idea of armoring an airplane is not new. European powers had decided that the weight required was prohibitive. Why then did the Germans succeed in solving the problem? Because the Zeppelins failed. Zeppelins had been successfully set on fire over London. A substitute had to be found if bombing was to be continued. And so the Germans invented the Gotha biplanes—mammoth machines driven by engines of unprecedented power, provided with fuel tanks of enormous capacity for long journeys, freighted with bombs weighing hundreds of pounds. Their arc of fire was not impeded in any direction. They could even shoot at a lower enemy through a tunnel. The British considered them almost equal in speed to all but the most recent small pursuit planes. True, they were unwieldy; they could not perform the gyrations of the smaller machines, but they could fight off faster machines armed only with fixed machine-guns firing through the propeller.

The Gothas and the similar Friedrichshafens and A.E.G.'s are intended to carry much fuel for long raids and a great weight of bombs. Suppose the bombs were abandoned altogether? Suppose that the radius of action, too, were reduced to that of a light, single-seated fighter, so that only a little fuel—enough for a two hour flight—need be carried? And then suppose that the weight represented by bombs and excess fuel were distributed in armor where it can do the most good? That seems to be the underlying idea of the new German battleplane. Fully twelve hundred pounds of armor can be hung on the machine's vitals if the principle is carried out. The essential point is that in order to be immune to the small fighting plane's bullets the giant Gotha requires but little more armor for adequate protection than a moderately sized machine.

The Merrimac of the Air

It is said that after Lufberry's death the German steel-clad flying tank was brought down. Whether it was or not, its appearance marks a new epoch in the

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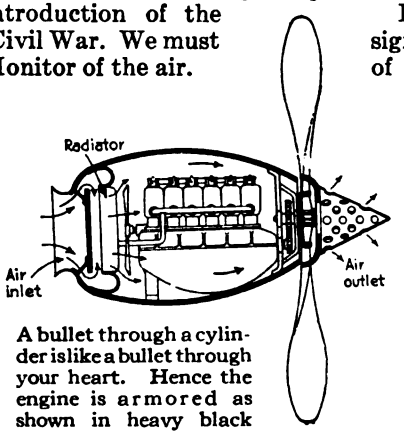
development of the military airplane, comparable with the revolution brought about by the introduction of the Merrimac in the Civil War. We must cast about for a Monitor of the air.

Size is in itself a kind of protection; for the larger the machine, the less are its beams, ribs and struts likely to suffer from bullets. Only a small part of the craft need be encased in steel. Since at least every tenth bullet is explosive and many more are burning torches, all wooden and woven parts must be chemically fire-proofed.



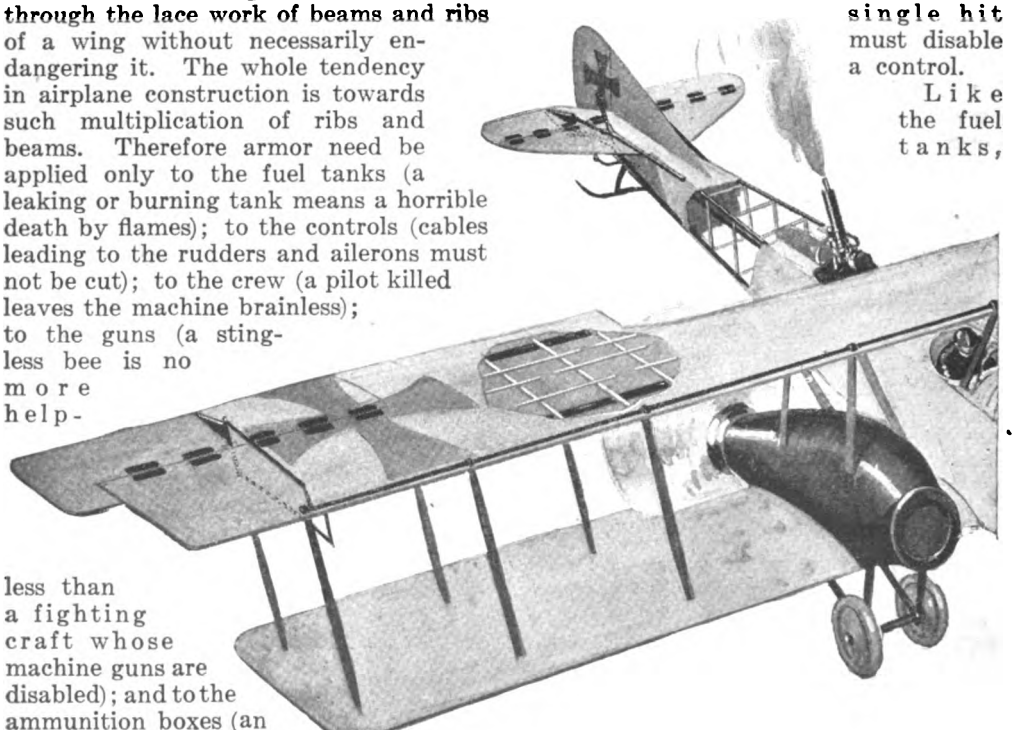
A bullet through a cylinder is like a bullet through your heart. Hence the engine is armored as shown in heavy black

The latticed masts of American battleships are so constructed that shots can pass through them without necessarily bringing them down. A similar principle may be adopted in building wing frames. Even now machine-gun bullets may rip through the lace work of beams and ribs of a wing without necessarily endangering it. The whole tendency in airplane construction is towards such multiplication of ribs and beams. Therefore armor need be applied only to the fuel tanks (a leaking or burning tank means a horrible death by flames); to the controls (cables leading to the rudders and ailerons must not be cut); to the crew (a pilot killed leaves the machine brainless); to the guns (a stingless bee is no more helpless than a fighting craft whose machine guns are disabled); and to the ammunition boxes (an explosion in a mass of cartridges is the equivalent of an explosion in a powder magazine).

How are the fuel tanks to be designed? The least possible amount of material must be utilized and yet the maximum volume obtained by a shape approaching a sphere's. The larger the tanks the better; for there is no proportionate increase of weight with increase of volume. An empty 500-gallon tank does not weigh a hundred times more than a 5-gallon tank. Let the steel be thick enough, and it becomes bullet-proof without other armoring.

The piping through which oil and gasoline is conducted must obviously pass through tubes of great thickness; control cables must be encased in armored tubes. Before the control wires emerge they are attached to bullet-proof chains. The exposed part of them must be shortened. The braces to which they are fastened must also be armored and joined to the rudder framing at many points. No single hit must disable a control.

Like the fuel tanks,



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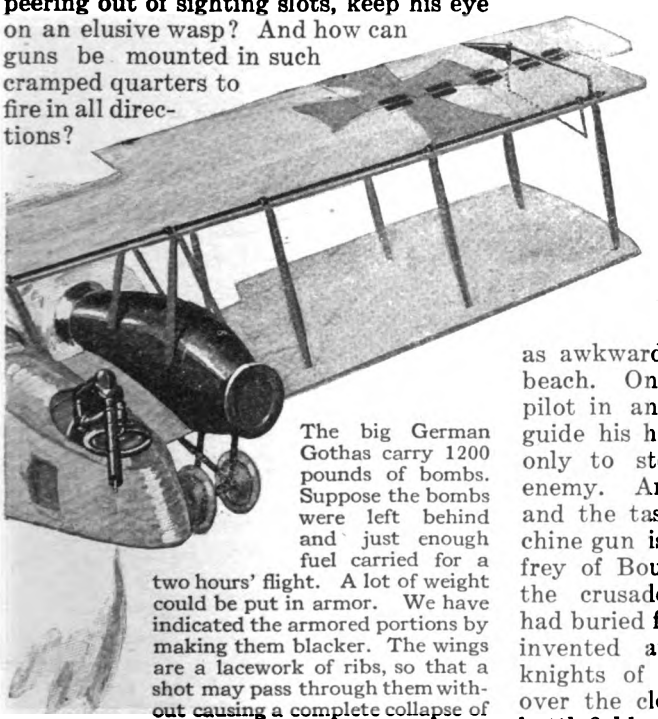
the engines may be greatly increased in volume and therefore in power without proportionately increasing their weight. Power depends on cubic capacity of cylinders. Hence a big engine may be armored, and yet its weight will be proportionately no greater than that of a smaller one. If the casing is to be bullet proof its weight need not be increased by more than three times.

Since we cannot have a battleship turret every man of the crew must wear a full suit of mail

Mail-Clad Knights of the Machine Gun

What of the crew? The pilot's is the guiding brain. The gunners are the fighters. Why not follow battleship practice? Armor the cockpits—that is the first thought that leaps to the mind. But must we copy battleships? How different are the conditions in the sky! The single-seated one-hundred-and-fifty-mile-an-hour fighter darts hither and thither like a wasp at such close range that his antagonist lives in the constant fear of seeing him vanish only to bob up in some new unexpected quarter. If the cockpits are to be armored protection must be provided on all sides. Do that and you convert them into completely enclosed turrets. But how can a man in a turret, peering out of sighting slots, keep his eye on an elusive wasp? And how can guns be mounted in such cramped quarters to fire in all directions?



The big German Gothas carry 1200 pounds of bombs. Suppose the bombs were left behind and just enough fuel carried for a two hours' flight. A lot of weight could be put in armor. We have indicated the armored portions by making them blacker. The wings are a lacework of ribs, so that a shot may pass through them without causing a complete collapse of the framing

For the present, at least, turrets are out of the question. What then? A startling plan suggests itself: *Armor the men in the cockpit.* The press reports of Lufberry's encounter with the flying tank state that the German crew were actually clad in mail. The reason becomes more and more obvious. The men have no time to revolve a sighting slot, which, in itself, limits their field of vision; they have too many other things to do.

The suit of armor worn by each man (a suit of far tougher steel than any 15th century armorer could have produced) must be a full suit. Remember that the bullets may pour in from any side. Body armor is lighter by far than turret armor. Modern science will make it far more flexible than the medieval knight's coat of mail. There is no need for much muscular action in firing a machine gun—scarcely as much as was needed for poising a lance. The mailed knight of the Middle Ages was about as awkward on foot as a penguin on a beach. On a horse he was much like a pilot in an airplane. He had only to guide his horse and charge; the pilot has only to steer his machine toward his enemy. Armor the men in the machine, and the task of aiming and firing a machine gun is not impeded. And so Godfrey of Bouillon, the Chevalier Bayard, the crusaders whom we thought we had buried for good when gunpowder was invented are restored to us again—knights of the machine gun skimming over the clouds of a twentieth century battlefield.

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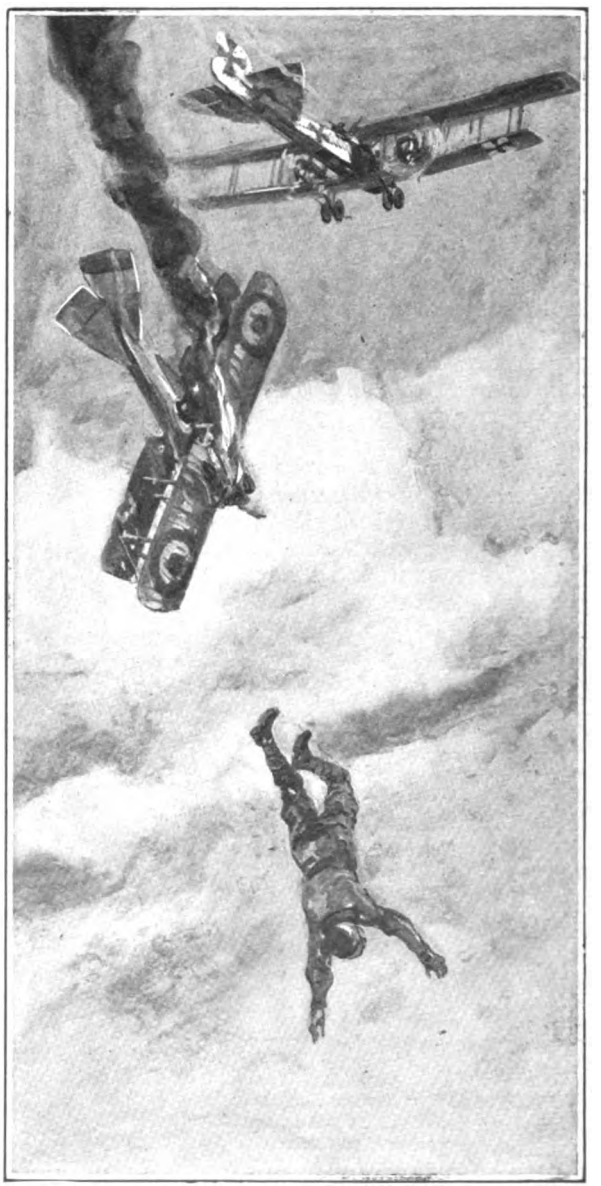
What next? We must evolve a Monitor of the clouds to fight this suddenly created Merrimac. The armored flying machine must be met with the shell fire of a small gun, something like the French thirty-seven millimeter weapon. Such a piece can be carried only on a machine as big as the Gotha. Gone are the old wasp-like tactics. Instead we see a more stately maneuvering for favorable positions. The ranges increase. Against shell fire machines cannot be armored heavily enough. Once the nose-spins, the-side-slipping, the tail-dives, the dodging, the looping, the "dead-leaf" gyrations that now characterize air fighting are abandoned, victory must belong to the more powerful gun, the gun that can shoot accurately for a considerable distance. Guns have always won battles since gunpowder was invented. It is so on land; it is so on the sea; and it is so in the air. But admit this and once more the Zeppelin looms up as an efficient possibility for long-range combat against the sluggish, mammoth cannon planes that are to play the parts of aeriel Monitors. Because of their enormous lifting capacity, because of their immense size, Zeppelins can carry a far more powerful battery than any mammoth steel-clad flying machine. But if the Zeppelin reappears, why should not its old enemy, the wasp-like single seated fighter also reappear? Why should it not be sent against the Zeppelin as it was sent against it so successfully over London?

It is a curious circle in which we find ourselves revolving dizzily. The single seated wasp-like fighter gives way to the armored plane, the Merrimac of the air; the armored plane gives way to the cannon plane, the Monitor capable of repulsing the aeriel Merrimac; the cannon plane gives way to the rigid, gas-inflated Zeppelin; the Zeppelin in turn gives way to the small, elusive, quick-maneuvering single-seated plane. Surely the air navy of the future must be a strange mixture of various types of aircraft.

Who knows but it may become a heterogeneous collection of a few Zeppelins hiding behind a vast army of flying machines, differing in size as well as in construction and armament!



He unbelts himself, rises and leaps from his flaming machine. A bruised almost unrecognizable mass is picked up in a flower garden

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Teaching Artillerymen to Handle the Big Guns

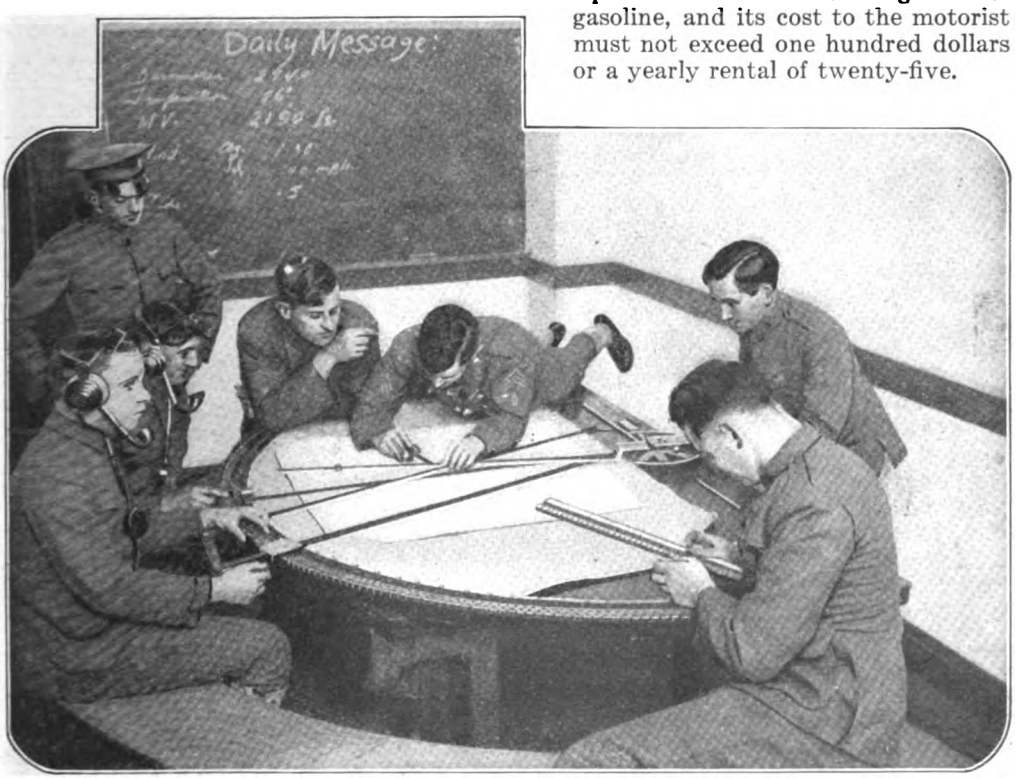
LONG range gunnery with the modern high power guns of large caliber is by no means a simple thing to learn. A great deal of mathematics and physics enters into the study of the complicated technical problems which this kind of gunnery presents. Many things have to be taken into account when one of these big guns is to be directed so as to hit a target many miles away. Atmospheric pressure, temperature, direction and velocity of the wind and many other conditions have to be considered.

One of the most difficult problems is the calculation of the curved path of the projectile and the exact determination of the angle of elevation of the gun.

The picture shows a number of artillery students working out problems at the plotting table. The plotting consists in the working out of certain trigonometric problems involved in finding azimuths, locating batteries, etc. The table shown in the picture is a device of great practical value to the directors of artillery fire. By purely mechanical methods it solves in a few minutes, problems, the solution of which without its help would require a great deal more time. This plotting table is being used with splendid results at the Presidio Coast Artillery School, near San Francisco.

$5,000 for Device to Use Coal-Gas as Automobile Fuel

THE Automobile Association and Motor Union, Fanum House, Whitcomb Street, London, W. C., is offering a prize of five thousand dollars to the inventor of a method by which coal-gas can be used as fuel for automobiles. The conditions governing the contest are that the container for the coal-gas must occupy not more than nineteen cubic feet of space, its weight must not exceed one hundred and forty pounds, it must contain the equivalent of two or three gallons of gasoline, and its cost to the motorist must not exceed one hundred dollars or a yearly rental of twenty-five.



The picture shows a class of young artillerymen studying long-range gunnery with the aid of a plotting table and working out various intricate trigonometric problems

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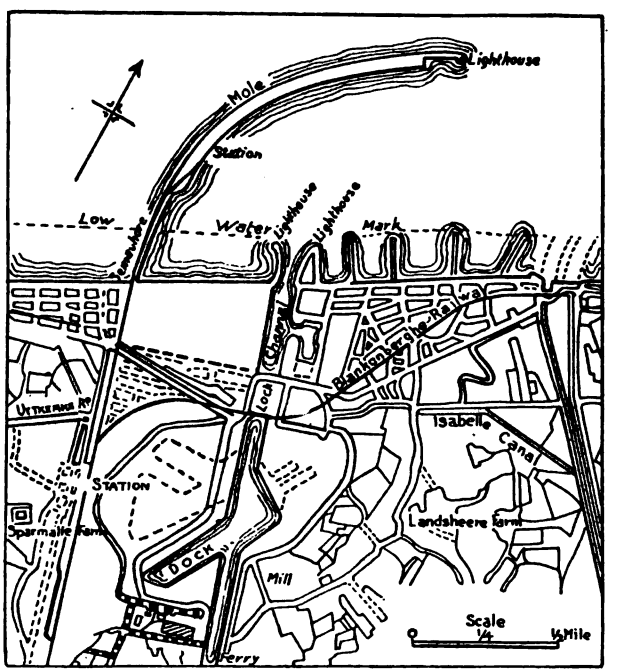
How Zeebrugge Harbor Was Bottled Up

By a daring and brilliant naval raid the British closed that German submarine base

DURING the night of Tuesday, April 23, of the present year, a British naval expedition under the command of Vice-Admiral Roger Keyes made a daring raid upon the German naval base of Zeebrugge. The raid was cleverly planned and so brilliantly executed, that important strategical advantages were gained, the most important being the blocking of the ship canal connecting Zeebrugge with Bruges.

Six obsolete cruisers, the *Brilliant*, *Sirius*, *Intrepid*, *Iphigenia*, *Thetis* and *Vindictive*, two Mersey ferryboats, the *Daffodil* and *Iris*, two antiquated submarines, and several destroyers beside a number of motor launches and other auxiliary craft constituted the raiding expedition which was convoyed by several modern cruisers, destroyers and monitors. The *Vindictive* was specially equipped for landing storming parties and carried batteries of Stokes mortars, flame throwers and other means of destruction; the other cruisers were filled with concrete and carried only small crews, all picked from the blue-jackets and royal marines, who had volunteered for the hazardous expedition. These cruisers were to be sunk in the harbor of Zeebrugge so as to block its channel to the German submarines which used the harbor as their base.



Map of Zeebrugge harbor, showing the mole and the canal, now blocked, connecting the harbor with Bruges, strong German base and important distributing center

The night was dark and starless and the sea in the channel choppy when the raiding expedition started on its journey. Shortly after midnight the light at the end of the mole which protects the harbor of Zeebrugge was sighted and, almost at the same time, the Germans sighted the approaching British fleet. A moment later star shells were fired by the German batteries and the mole as well as the approaching fleet was brilliantly lighted by many search-lights from the shore.

This was the signal for a terrific bombardment. The British monitors and cruisers opened fire upon the defenses and the important buildings of Zeebrugge and continued their bombardment for an hour, while the Germans showered a hail of projectiles of various calibers upon the raiding fleet and the British and French cruisers and monitors which were supporting them.

During the progress of the bombardment the British raiding cruisers, under the cover of a smoke screen, continued their way toward their objective points. The *Vindictive*, accompanied by the *Daffodil* and the *Iris* had almost reached

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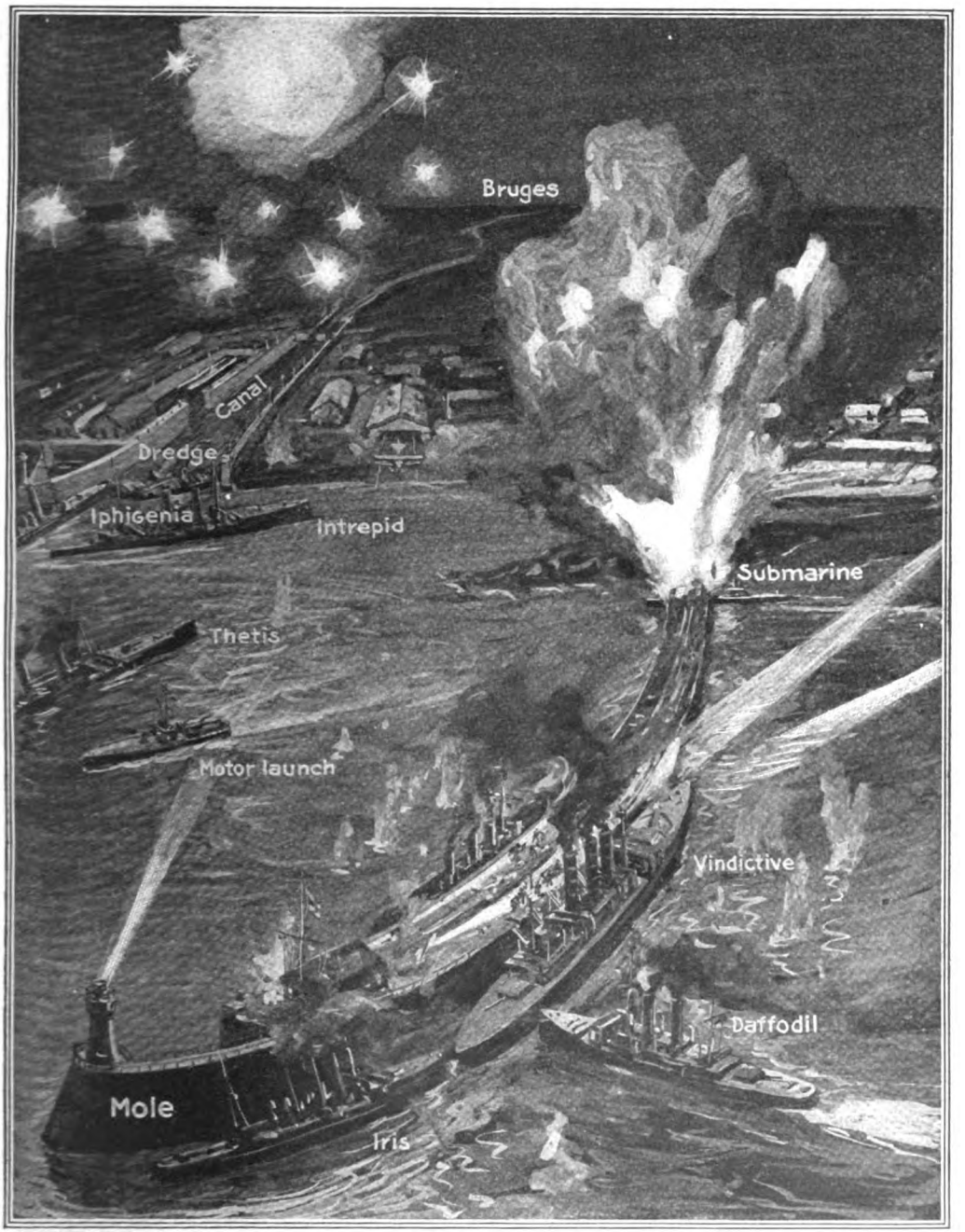

Bird's-eye view of the successful British raid upon the German submarine base at Zeebrugge. Note position of blocking cruisers and how the Daffodil held the Vindictive against the mole

the mole unnoticed, when the wind shifted, disclosing them to the Germans. Notwithstanding the terrific fire which the German guns of the coast batteries directed upon the ships, the *Vindictive* steamed up to the mole and, with her bow toward the shore, anchored alongside the stone structure of the mole which extends in a curve to a distance of more than 8,000 feet. The stone work of the

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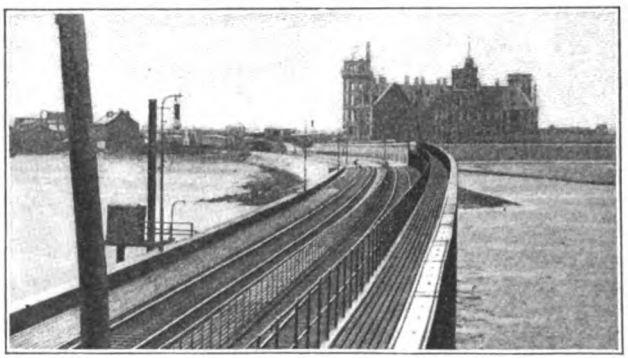
mole protected the lower part of the *Vindictive's* hull, but her superstructure, the bridge, deck cabins and smoke stacks were riddled and torn by hundreds of shells and other projectiles fired at comparatively short range.

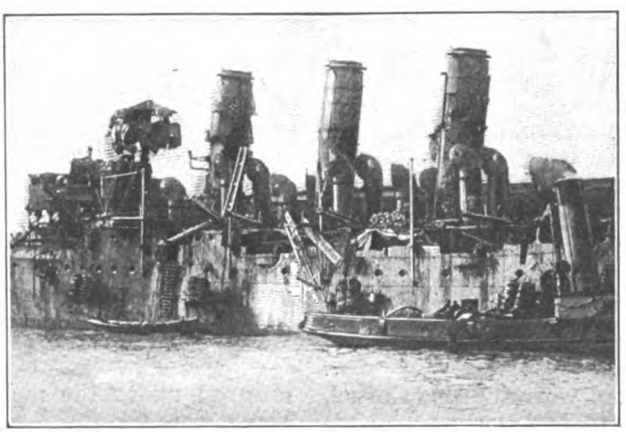
While the *Daffodil*, headed at right angles to the mole, pressed with her bow against the starboard side of the *Vindictive* to hold her against the stone wall, the cruiser landed a storming party of five hundred men armed with hand grenades and Lewis guns. The raiders were attacked by a force of German marines and in the desperate hand-to-hand struggle many were killed. The British blue-jackets disabled several big German guns and did other damage during the hour which elapsed before the survivors were ordered back on board. The principal object of landing the storming party was to create a diversion that would detract the attention of the Germans from the main feature of the raid, the blocking of the channel.



Looking toward the shore end of the Zeebrugge mole. Connection with the shore is cut off by a gap of 120 feet

Practically unobserved, three of the blocking cruisers, accompanied by one of the old submarines, loaded with powerful explosives, and a few motor launches rounded the end of the mole and steamed into the harbor, followed by two destroyers. The searchlights of the Germans soon "spotted" them and the harbor batteries received them with a furious fire. The *Thetis* ran aground before she had reached her objective point, but the *Iphigenia* and the *Intrepid* made their way to the entrance of the Bruges Canal. The *Iphigenia* destroyed a steam dredge in the channel before she was sent to the bottom and the *Intrepid* was sunk in a position so as to close completely the entrance to the canal.

The submarine, guided by one of the destroyers, made its way toward the pile trestle connecting the stone mole with the shore. It was wedged between the piles and abandoned by the crew, after they had set the time fuse which was to set off the explosives in the hold. The men, like the survivors of the crews of the *Iphigenia* and *Intrepid* were picked up by some of the motor launches and later transferred to a destroyer. Two minutes after the British submarine had been abandoned by her crew, the explosives in the hold blew up with tremendous force, making a gap of 120 feet between the mole and the shore. Many German marines on the trestle at the time were killed by the explosion.



© Underwood and Underwood

When the Vindictive returned to her base her upper works were riddled by the terrific fire of the Germans

The object of the raid being gained, the signal for withdrawing was given by the commander. The remaining ships withdrew under the furious barrage fire kept up by the German batteries and returned safely to their base.

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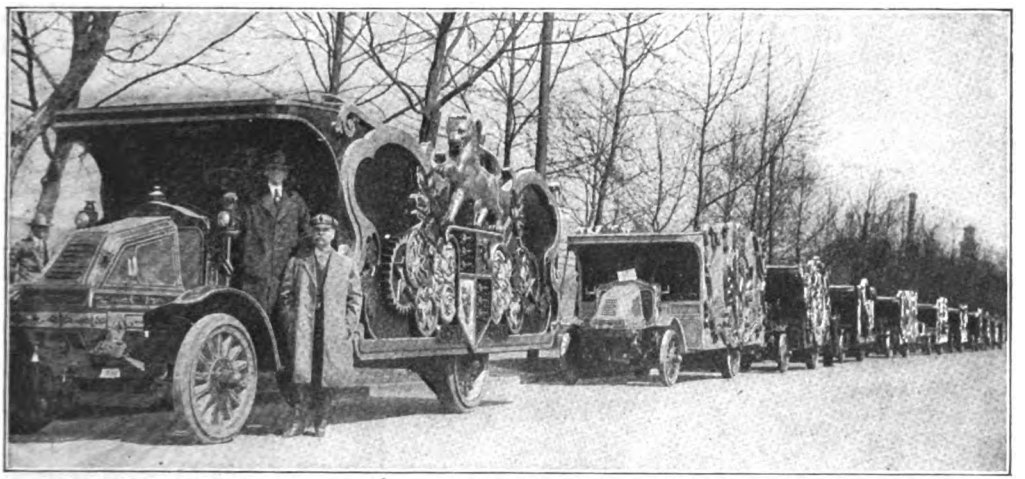

A glimpse of the automobile circus procession—it's fifty city blocks long. Each vehicle is decked out like Solomon in all his glory. Why motor trucks? To reach towns off the railway lines

Solomon in All His Glory Was Not So Glorious as the Motor Circus

THIS is to inform prospective patrons that what the press agent calls the "great, grand, gorgeous, glittering, gigantic automobile circus," which POPULAR SCIENCE MONTHLY told about a year ago, is again making its way through the country with "six hundred thousand dollars' worth of pure gold leaf on one hundred and fifty motor trucks." The whole circus is being transported in automobiles, including the menagerie, the kitchen and the sleeping quarters for the show folk.

The trucks are driven by engines of one hundred and fifty horsepower each. The procession extends for fifty city blocks. Gasoline and oil follow the caravan in tank cars, and caterpillar tractors are on hand to pull the trucks out of ruts. Each car is driven by a sixty-horsepower engine.

Jumps limited to thirty miles a day are being made, so that remote hamlets which have been denied the privilege of seeing a circus can be visited. However, the circus employees of the old school, who drove immense vans drawn by horses, will be missed, their places having been taken by chauffeurs.

The circus began its tour from Toledo, Ohio.

A Sammy Wears Nine Pairs of Shoes a Year

THE shipments of shoes for our forces in France, according to General Pershing's demands, aggregate 18,590 pairs for each 25,000 men a month, or about nine pairs a year for each man. This large supply is to continue only until a reserve store has been accumulated. A total of 15,437,000 pairs of shoes have so far been received or contracted for by the Quartermaster-General's department.

Sticks Give Way to Reel and Line in Marking Out Garden Rows

The reel and line used in marking out garden rows with method

IF you happen to observe your neighbor marking out rows in his garden by the time-worn method of employing two sticks at the ends of a string, tell him that he can save time and energy by using a means devised by J. F. Hatch, a fertilizer clerk in the North Carolina Department of Agriculture. It is described as the "garden reel and line."

This is the way it operates: The thread is kept on a spool which unwinds as the garden-maker walks. The unwinding of the thread is stopped by pushing in a catch on the ratchet wheel at one side of the device.

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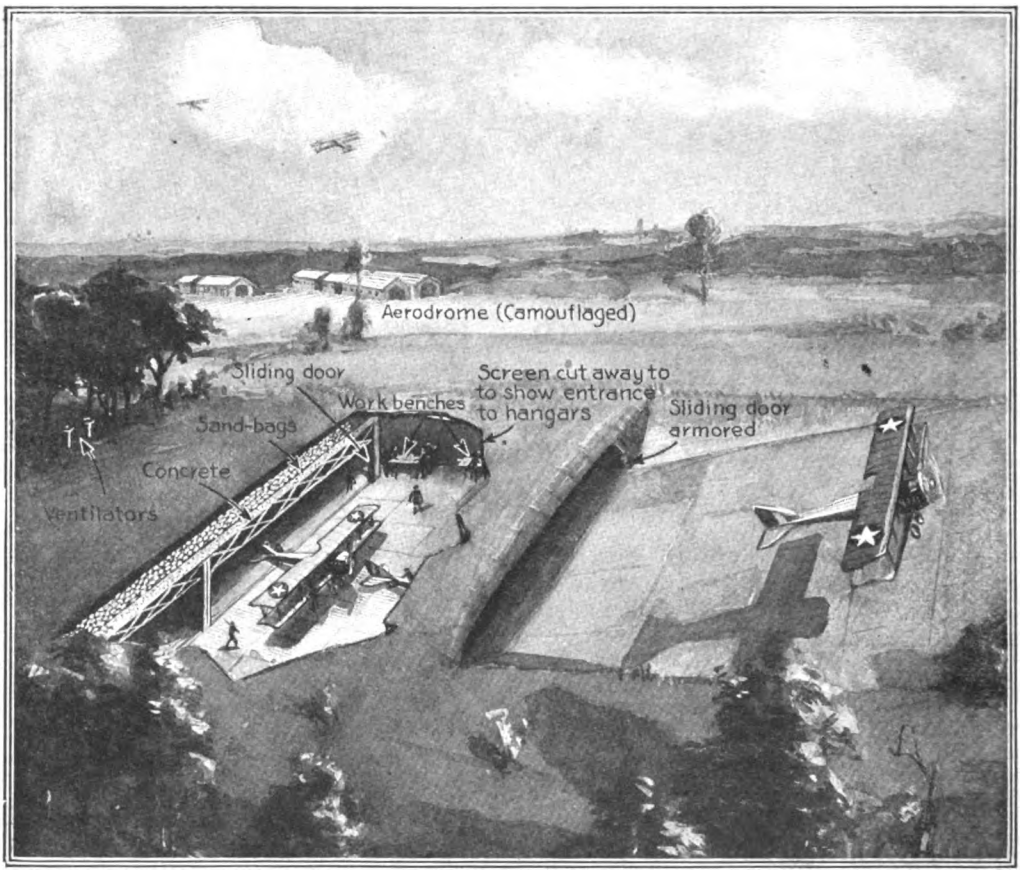
The Airplane Becomes a Mole

A single bomb can do more damage to a flying machine than a day's fighting in the air. Hence the underground hangar appears

By Carl Dienstbach



German underground hangars on the western front. The picture shows the entrance with the elaborate precautions taken to conceal and protect the machines from bombs

THE military airdromes with their hangars and repair shops near the fighting front rival railway stations in tactical importance, and, for that reason, are favorite targets for the enemy's airbombs. More airplanes are destroyed in their hangars by one successful bombing raid than in many days' fighting in the air. The destruction or damaging of repairing and "tuning up" facilities is also a serious matter. Hence it is not astonishing that the Germans are now housing their airplanes under ground.

It soon became clear that hangars at the front would have to be built underground like those in a fortress within range of the enemy's shells. But hangars cannot be put underground as easily as barracks or munition magazines. Airplanes, with their enormous wings demand a great deal of space and cannot easily be stowed away in a hole in the earth.

Large, and at the same time unobstructed underground spaces would necessitate very elaborate and costly supports for the ceiling. They also would have to

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be placed at a great depth to make the roof bomb-proof. This would, in turn, make it necessary to construct a deep, long inclined open ditch by means of which the airplanes get in or out. Such a ditch would be hard to dig and would be easily clogged by the enemy's bombs or shells.

The most practical and most economical form for an underground hangar is a long tunnel, just wide enough to accommodate a single file of airplanes. This form is necessary to give to the roof the greatest possible strength to resist bombs, without using too expensive a construction of girders and without going too far underneath the surface. The runway ditch, leading gradually down into the hangar, must have slanting side walls to give it strength to resist the effect of bombs. The floor and the sides of the ditch should be covered with a continuous layer of one-inch armor plates. Sliding doors armored with two-inch steel plates and running on ball-bearing rollers on tracks must be provided.

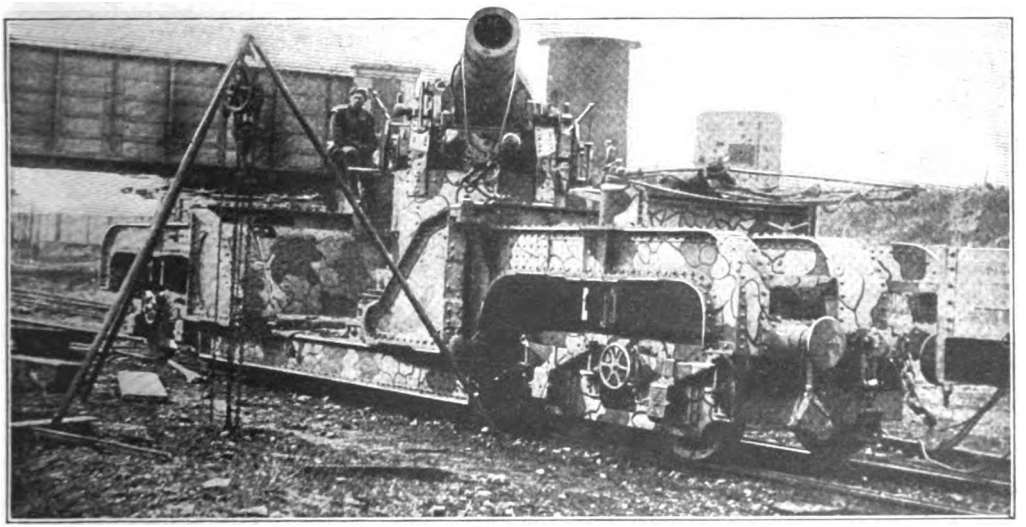
To ventilate the hangar, air shafts should be provided, leading to high chimneys some distance from the underground structure. This is necessary in view of the fact that the hangar in its side galleries gives shelter to the repair shops, forges and magazines as well as to the living quarters of the men who work in it. The interior must be supplied liberally with electric light and drinkable water.

Making Believe with Paint and Brush at the Front

THE observer in the airplane tries in vain to locate the enemy gun; his eye, looking through a telescope, fails to detect its muzzle through the foliage. So he flies away and the gun is not attacked.

This is an example of camouflage as it is practiced in the European war. And the camoufleur is so expert that his business of fooling the enemy has become an art.

An early use of camouflage by the French was the application of paint to big guns in order to make them resemble the foliage in which they were partly concealed. However, when the guns had to be placed in the open the disguise only accentuated their visibility. The protective coloration of birds and animals gave a hint to the camoufleurs who saw that it disguised the outlines of these creatures and counteracted to a considerable degree their undershadows. So the high lights along the gun barrels were darkened and their under surfaces lightened. The colors of the paint, of course, harmonized with the surrounding objects. The finishing touches to this work consisted in irregular streakings and blotches which broke the outlines and at least confused the observer if they did not serve to produce invisibility.



This big British gun is being made ready for the front with the aid of brush and paint applied by artists, who make it appear as part of the landscape

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Link Buttons That Keep Cuffs Up to Avoid Soiling Them

THE wearer of the new link cuff buttons can raise the cuffs as high up the arm as he pleases—to any position. The links automatically open when the cuffs are raised and close when they are lowered.

Attached to the links are two small parallel wire arms with oval buttons on the cuff ends and a small flat spring with retaining clasps on the other end. The links form a V-shaped device that spreads apart when the cuffs are raised on the forearm and is drawn together by the spring when they are lowered. The cuffs are kept in the place desired by the clasps which grip the sleeve.

These link buttons prevent the cuffs from being soiled

Making the Small Checking Account Pay. A Bank Problem Solved

THE invention of the unique form of check (herewith reproduced) is due to David B. Wheeler, a machinist by trade. It does away with costly bookkeeping and renders the handling of small checking accounts profitable.

When making a deposit, the depositor fills in all the blanks on the face of the check except that for the official's signature. He then hands the book to the receiving teller, together with the cash. The teller receives the money, signs his name and tears off the stub to keep as his record of the transaction and receipt from the depositor for the certificate of withdrawal.

The check now becomes a potential certified check. To convert it into cash at any time it is only necessary for the depositor to fill out the reverse side as is shown in the illustration. Actual experiment has demonstrated that these checks are honored not only by the banks and clearing houses, but that they are accepted by merchants as if they were cash. The cancelled check eventually finds its way back to the bank of issue where by means of the serial number it is matched up with the stub and the transaction is completed.

By the ingenious device of issuing these checks in the sums of one, two, four and multiples of four dollars, it is possible to reckon and pay interest. This unique combination of check, receipt, certificate of deposit and withdrawal order, invented by Mr. Wheeler, constitutes the Wheeler system of accounts, which has been successfully used by the Equity Savings Bank of Washington.

The face and reverse side of the check invented by Mr. Wheeler, which has been adopted by a Washington bank and used with marked success

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Cooking Under the Ground for British Soldiers

THE life of a British soldier in France is not made up entirely of dodging shells and bullets and going "over the top." He spends some time in looking out for the inner man. For he has learned that a soldier does not fight well on an empty stomach and that properly cooked food is essential to efficiency.

Food can not be safely prepared in positions exposed to the fire of the Germans. The cooks might be driven away from the stove by the concentrated fire of machine guns at a critical period in the broiling of the meat.

Therefore the underground kitchen was built. It has many of the conveniences found in the home of the careful housewife and some features which her kitchen does not possess. For example, the food from the underground kitchen shown in the accompanying illustration is brought to the surface of the earth by means of a windlass. This kitchen is located in a bomb-proof subterranean chamber and although the Germans raked the surrounding sections with shells and bullets, the culinary arrangements of the British remained undisturbed. After the Germans had retreated the British received the food that had been prepared.

The picture at the right gives a good idea of the construction of the underground kitchen with its dumbwaiter.

British soldiers hauling up food from an underground kitchen

© Int. Film Serv.

These cleverly camouflaged miniature warships made a great hit during the Liberty Loan campaign in Boston

Miniature Warships Aiding in Liberty Loan Campaign

ONE of the many interesting features of the last Liberty Loan campaign in Boston was the use of miniature copies of a torpedo boat and of a submarine on the Charles River basin. Both ships were manned by United States sailors and attracted considerable attention by their camouflage coloring. The torpedo boat, towing the submarine, cruised back and forth in the basin, while large crowds from Boston and Cambridge lined the banks and cheered the oddly painted craft. From time to time the miniature warships ran up close to the bank and the crews sold Liberty Bonds from the deck.

Of all the devices used in the Third Liberty Loan campaign this was the most novel, inspiring and appealing.

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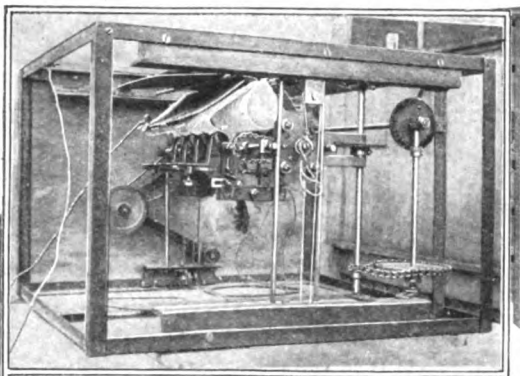
Doing It with Tools and Machines

Magnetic chucks cause the parts machined to become magnetized. This device neutralizes the magnetism

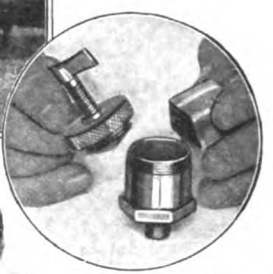
This book fumigating machine turns the leaves by an electric motor so that the fumes reach the whole surface



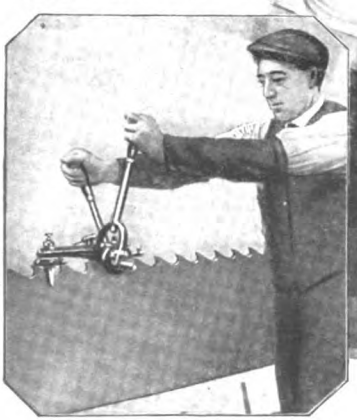
Steel drawers in a steel rack to hold heavy articles. The picture shows their strength

A wagon trailer leader for loading grain sacks. It is operated by a small gasoline engine

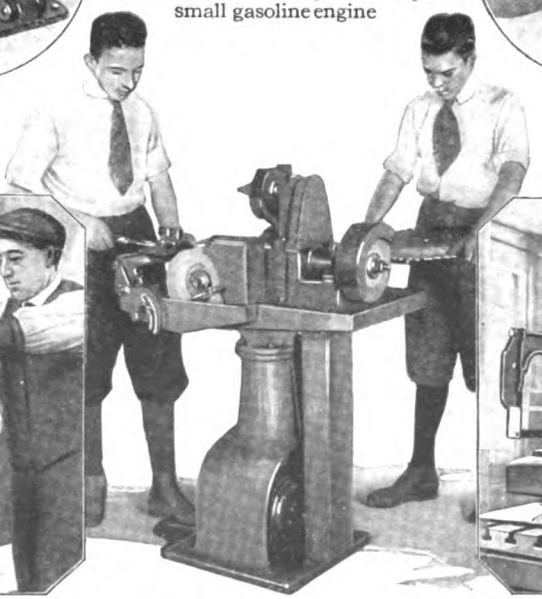
Drawing the rope through this machine measures and registers it up to one hundred feet



A grease cup which is supplied with grease held in paper capsules



A swage with oval die, for use on large saw teeth



This grinder has oil stones for sharpening wood-working tools

Hacksaw blades are used on this frame attachment

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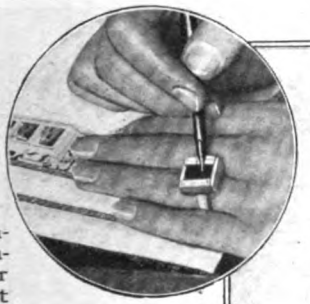
Saving Time and Labor in the Modern Office

A table constructed for use with a calculating machine. The table has a sloping top

Carbon sheet holder constructed on the principle of the ordinary curtain shade roller

A compactly built addressing machine designed for the addressing of shipping tags

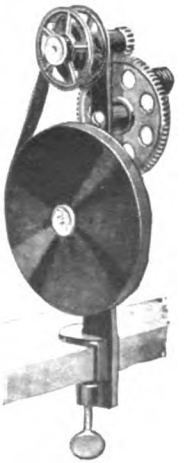


Rubber pen-wiper on a finger ring for helping out the draftsman

A roll holder for gummed labels which are to be marked by the typewriter to which it is attached

Pencil holder that holds short pencils

A chair suitable for school, lecture or lunch room. Has one wide arm rest



This little machine rewinds your typewriter ribbon without soiling fingers

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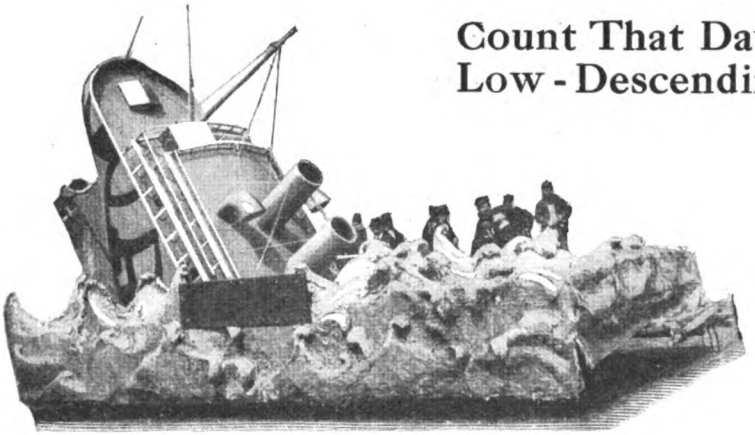
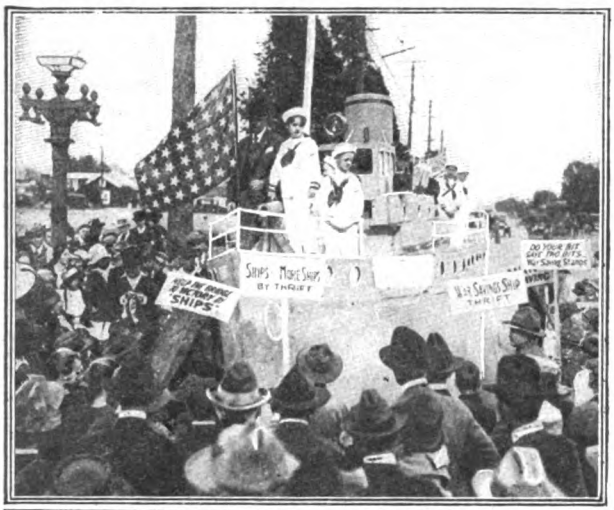
Count That Day Lost Whose Low-Descending Sun Sees

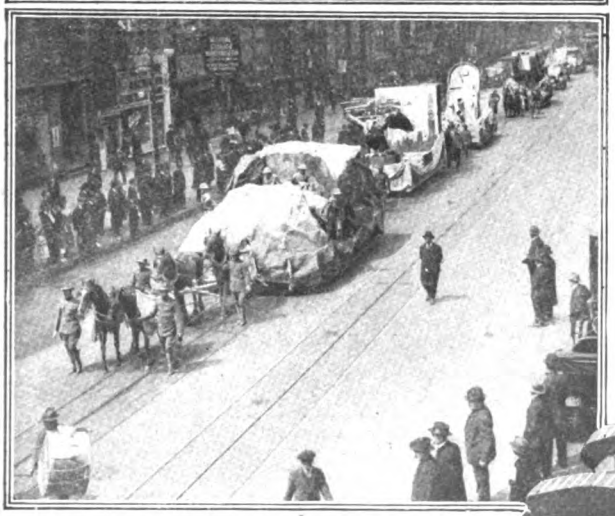


One of the realistic floats in New York's Liberty Loan parade, which attracted unusual attention and applause



A Thrift Ship manned by school children was one of the most successful features of the recent parade at Los Angeles, Cal.

Leo Dulmage, the heavyweight champion unicycle rider of the world, assisted the Liberty Bond drive in New York city



The imitation of a British tank in the children's pageant in Los Angeles strongly appealed to the crowds of cheering spectators

The picture above shows the first floats leading the great Liberty Loan Parade at the last drive in Greater New York

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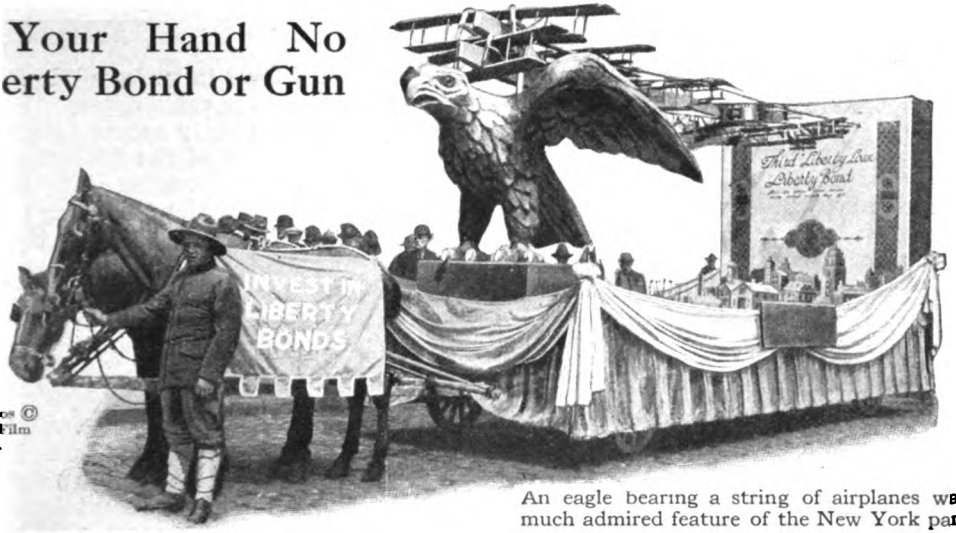
in Your Hand No Liberty Bond or Gun



Photos © Int. Film Serv.

An eagle bearing a string of airplanes was a much admired feature of the New York parade

The picture shows the speakers' stage in front of the New York Public Library during a Liberty Loan rally. Many thousand persons heard the speakers during the campaign

The Thrift Ship of the Los Angeles school children crossing the famous winding viaduct over the Arroyo Secco

A pavilion in the shape of a large bell formed the background for the speakers in City Hall Square, New York

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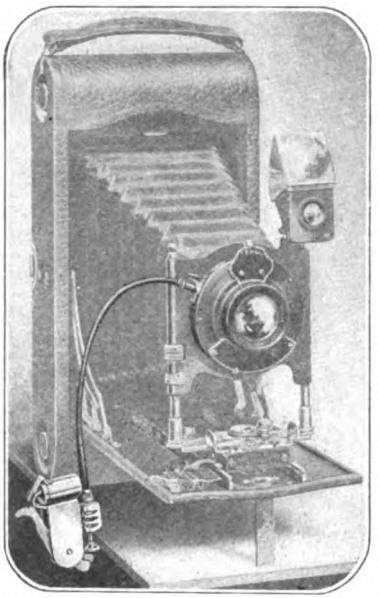
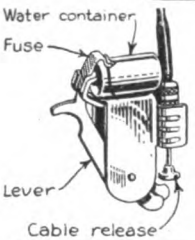
The Camera Man Gets into the Group Picture

"YOU ought to be in this photograph," is frequently said to the amateur photographer when he is showing a snapshot that he has taken. He could be in the picture, even if it is a snapshot, if he were to use a device which has recently been introduced.

The invention is attached to the cable release of the camera, as shown in the accompanying photograph. The cylinder-shaped container is filled with water and a wick made of cotton inserted in it to convey moisture to a strip of blotting paper which is used as a "fuse." The blotting paper is passed through a holder so as to come in contact with the wick and absorb the moisture. A lever forced downward by a spring operates the cable release, being held by the "fuse" in the position in which it is shown.

When the camera is ready to be snapped the "fuse" is inserted in the holder and the water from the wick gradually soaks through the blotting paper till it becomes pliant and permits the lever to be forced downward and actuate the cable release. Between fifteen and twenty seconds elapse between the insertion of the "fuse" and the operation of the camera shutter, giving the photographer ample time to take his place in the group to be photographed.





The device attached to the cable release permits the photographer to "get in" the picture

Water moistens the "fuse." This becomes so soft that it allows the lever to be forced downward by a spring

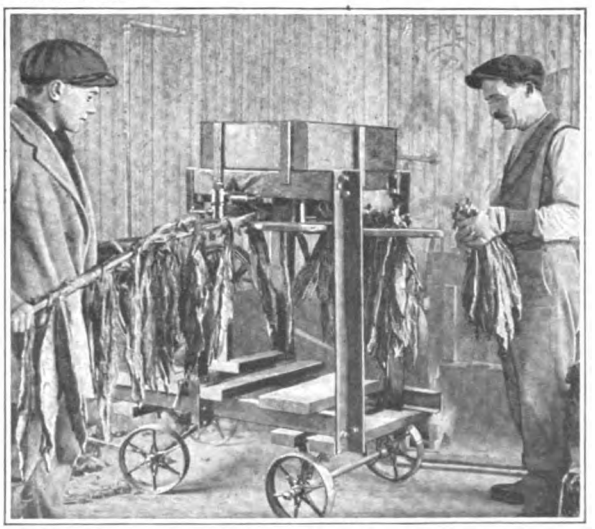
A Machine That Strips Tobacco Rapidly

A MACHINE invented by William H. Seaver of Agawam, Mass., not only strips tobacco faster than is possible by hand, but at the same time it cuts the stalks into lengths suitable for use in fertilizing the ground.

The stalks, fed by hand between two wheels, pass between the stripping wheel and a belt. The stripping wheel and the belt move slightly faster than the feed wheels, and as a result the leaves are pulled from the stalks and deposited at one side of the machine.

Continuing to pass through the machine after they have been stripped of their leaves, the stalks are drawn between a plain wheel and a wheel set with knives and cut into three-inch lengths. They are then ejected through a chute into a pile behind the machine.

The machine is operated by a gasoline engine and is installed on a light truck



This machine strips tobacco and prepares the stalks for fertilizing land at the same time

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You Cannot Lose or Misplace This Collapsible Funnel

"THERE is a spring—let's stop there for a drink!"

At this suggestion of his companion the man driving the automobile steered his machine to the side of the road and stopped within a few yards of the spring.

"Now we should give a drink to our horse," jokingly suggested the driver's companion, after they had refreshed themselves.

"That's exactly what we'll have to do if we want to avoid trouble," answered the other. "The water around the radiator is nearly boiled away."

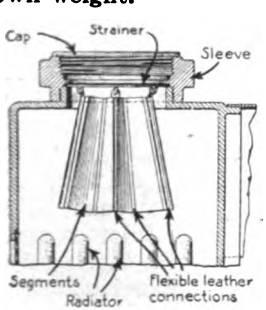
"Well, there is enough water in this spring," remarked his companion, "but it puzzles me how you can get it into the cooling jacket. Surely, you don't expect to fill the tank by pouring in the water with our drinking cups?"

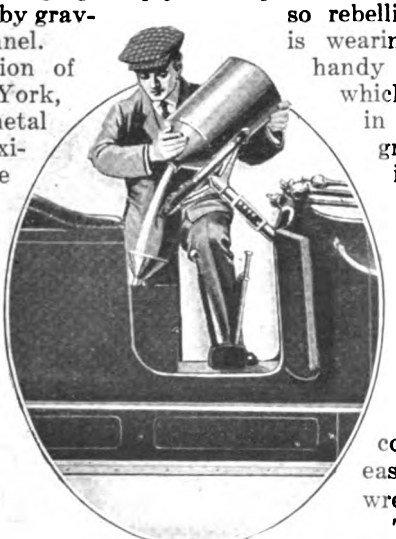
"You shall see in a minute," said the other, producing a collapsible canvas bucket, which he handed to his friend.

"While you fill this, I'll unscrew the cap and get things ready for filling the tank."

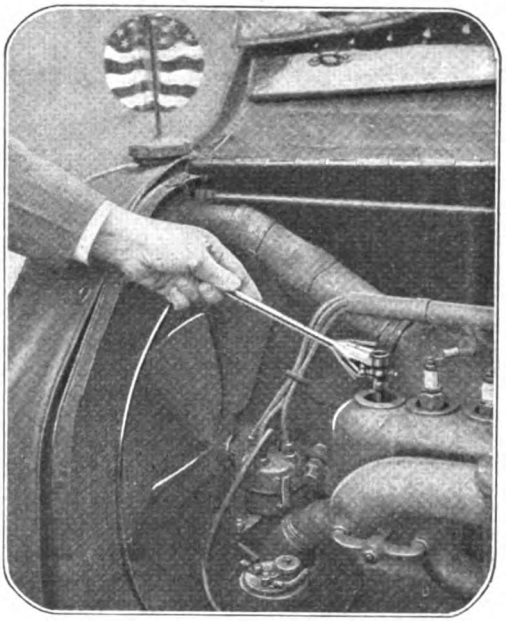
Cautiously he unscrewed the cap which was still uncomfortably hot. Then he unscrewed the strainer set in a double-threaded ring which covered the opening to the cooling tank. When he turned the contrivance upside down, the collapsible funnel, which had been hanging limply inside the cooler, unfolded by gravity and formed a large funnel.

The device, an invention of Harry S. Welsh of New York, consists of a number of metal segments connected by flexible hinges of leather or some other material, so as to form a cone or funnel when expanded by their own weight.





A collapsible funnel attached to the cap of the cooling jacket



It will not soil your hands to turn the cocks or grease-cup of forward spring pin

Making It Easy to Turn the Grease-Cups of an Automobile

THE grease- or oil-cups of an automobile need attention from time to time. This adjustment is one of those disagreeable duties that every automobilist has to perform. It is particularly exasperating that the oil-cups are never so rebellious as when the driver is wearing his best clothes. A handy little grease-cup wrench, which has recently been placed in the market, will be a great help to automobilists in such emergencies. With the aid of this wrench, which has a long handle and fits any size or shape of grease-cup or cock, he can reach any refractory cup or cock and turn it without soiling his fingers and cuffs. Primer cocks, drain cocks and pet cocks are as easily operated on with the wrench as are grease-cups.

This little tool is a handy thing to have in your tool kit.

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Running Your Car with Push-Buttons

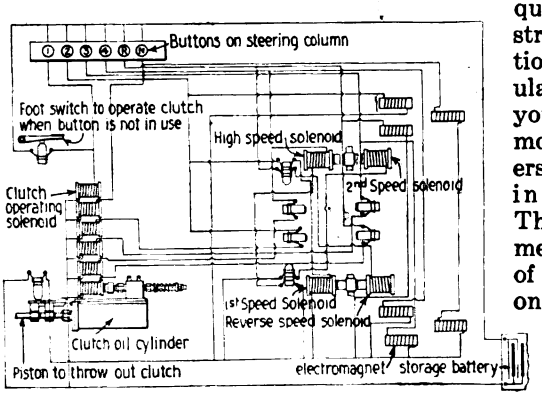
The device that won the Popular Science Monthly's automobile labor-saving contest. No effort required to shift gears or to push down on the clutch pedal

As promised last month we publish a description and pictures of the electrically-operated gear-shifter with an automatic clutch throw-out which was invented by Mr. C. A. Butterworth of Newton Center, Mass., and which won the first prize in the POPULAR SCIENCE MONTHLY contest for the best ideas on labor-saving automobile devices.

Its use eliminates the physical exertion expended in the present type of car every time it is necessary to shift gears and in addition does away with the physical labor required of the foot to push down on the clutch pedal and disconnect the engine from the driving mechanism each time the gears are to be shifted.

In brief, the electrically-controlled gear-shifter is made up of a series of solenoid switches which are opened and closed at will by means of interconnected switch buttons arranged in a small case on the steering column so that only one switch can be closed at any one time. There is one switch and button for the neutral position of the gears and one for each of the forward speeds and one for reverse speed. As soon as a switch is closed, the circuit electrically opens a small valve in a little oil cylinder near the clutch housing. The opening of this valve permits the oil to flow into the cylinder from the pressure oil tank which forms a part of the equipment and the oil in turn forces a piston in the cylinder forward until the clutch is thrown out. At the same time that the clutch circuit is closed, a second circuit is closed through a solenoid to operate a bar controlling the intake valve to one of two oil cylinders fed from the same oil pressure tank as the clutch throw-out cylinder. One of the two oil cylinders serves to shift two of the forward gears by the movement of its piston, and the other cylinder and its piston serve to shift the reverse gear and the third forward speed gear in case of a three-speed and reverse gearbox. When the oil in either cylinder has forced the piston out sufficiently to shift from one gear to the next, a stop on the piston rod strikes a contact point and breaks the circuit holding the clutch piston out of its cylinder so that the exhaust valve on the cylinder is opened. The clutch spring then tends to force back the piston, but as the exhaust port is considerably smaller than the inlet, the oil escapes slowly and thus permits the clutch to come into contact gradually. The change from one gear to any other is made in a similar manner according to the button pressed. The arrangement of the solenoids and oil cylinders is shown in the illustration opposite and the wiring diagram on this page.

Picture to yourself how much this invention, if embodied in the mechanism of your automobile, would add to your comfort in driving. Instead of doing hard physical labor every time it becomes necessary to change the speed you run your car, accelerate its speed, retard or reverse it simply by pressing a little button. To produce these changes requires scarcely more strength and exertion than to manipulate the keys of your typewriter. No more pushing of levers, no more throwing of clutches! This would, indeed, mean a great saving of labor, as every one familiar with the driving of an automobile will know and most thoroughly appreciate.



Arrangement of solenoids and the wiring in Mr. Butterworth's prize-winning invention

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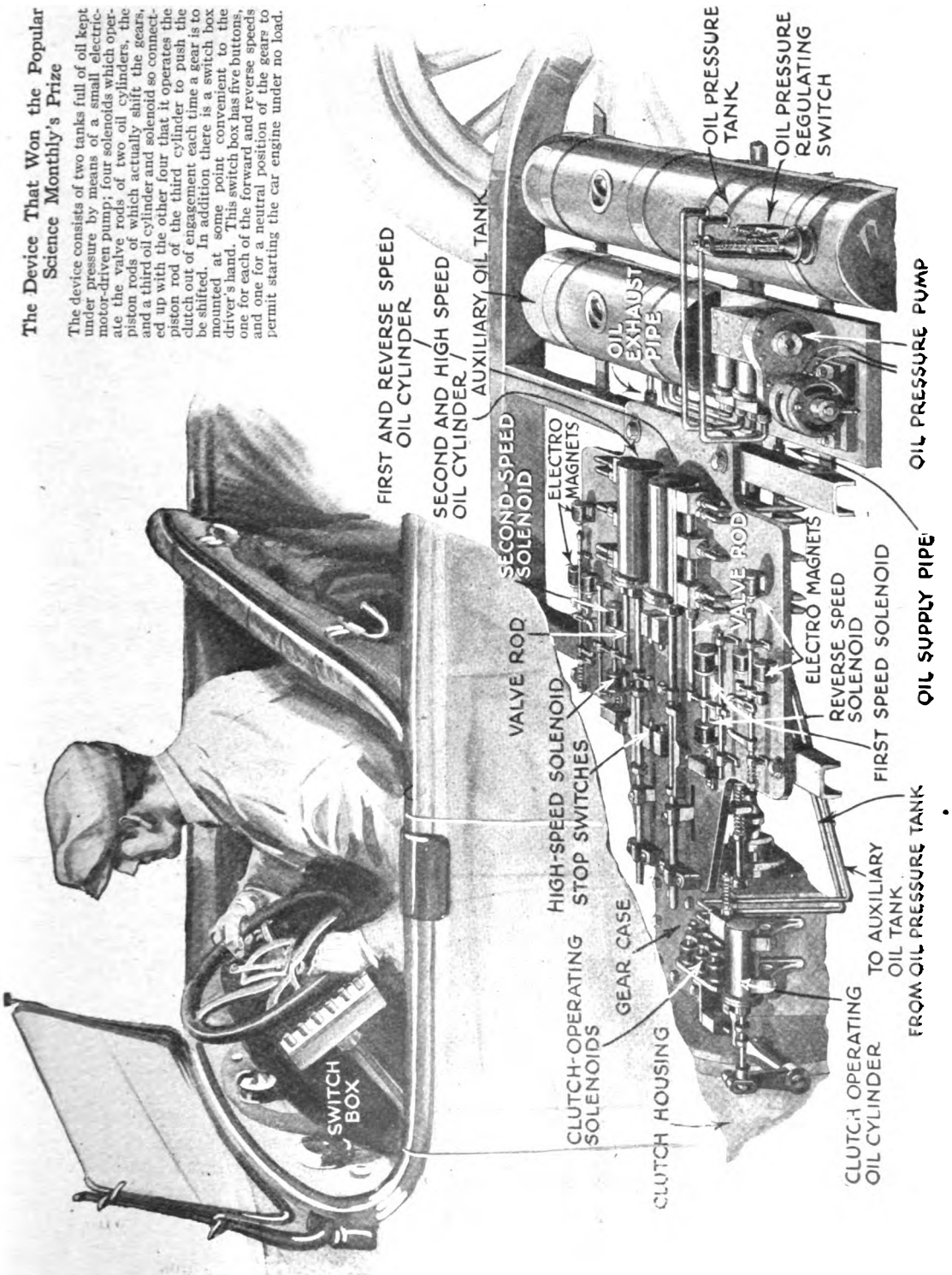

The Device That Won the Popular Science Monthly's Prize

The device consists of two tanks full of oil kept under pressure by means of a small electric-motor-driven pump; four solenoids which operate the valve rods of two oil cylinders, the piston rods of which actually shift the gears, and a third oil cylinder and solenoid so connected up with the other four that it operates the piston rod of the third cylinder to push the clutch out of engagement each time a gear is to be shifted. In addition there is a switch box mounted at some point convenient to the driver's hand. This switch box has five buttons, one for each of the forward and reverse speeds and one for a neutral position of the gear to permit starting the car engine under no load.

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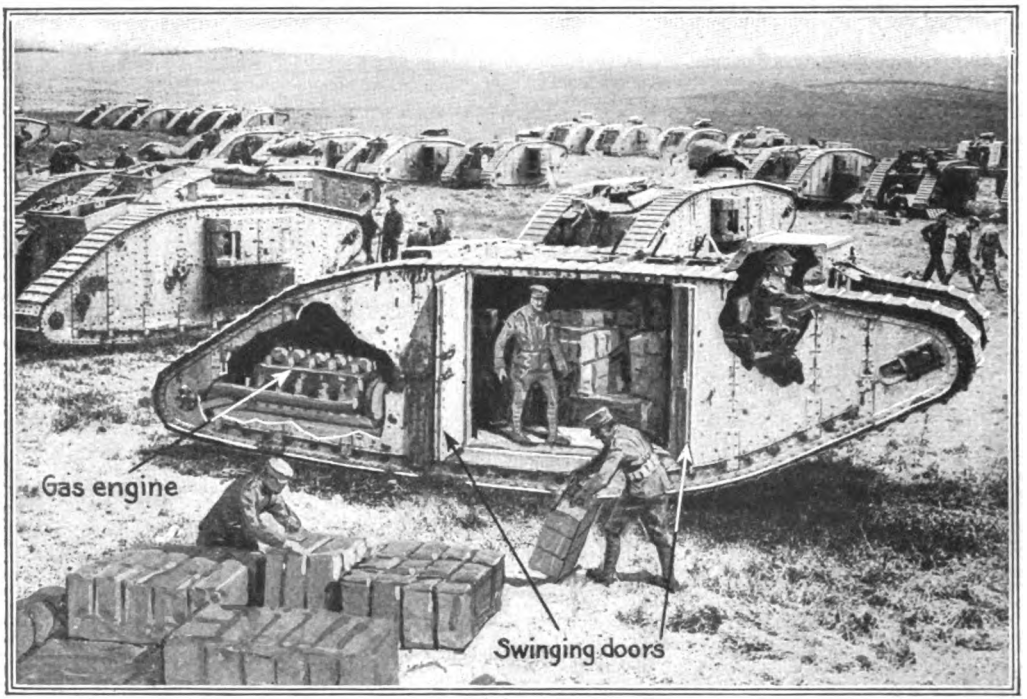
Now Comes the Cargo-Carrying Tank

It crawls across country so as to avoid the fire to which roads are subjected at night

By Joseph Brinker



A British tank on the western front being loaded at the base, some distance back of the line, for its journey to the trenches

EXCEPT in great offensives or retreats such as have taken place this spring, it is said on good authority that more men are killed every night in bringing supplies to the trenches than by fighting. This follows from the fact that the troops are fairly well protected in the trenches when under rifle or machine gun fire and in their deep dugouts when the artillery is in action.

Supplies are brought up as near as possible to the front distributing points by means of motor trucks and horses and then carried across the open fields or in communication trenches by men who have practically no protection against shell splinters or machine gun fire. The enemy knows the roads by which supplies are brought up because of the information secured by his airplane observers. He plots every yard of a transport road accurately on his maps and then distributes his artillery in such a manner that it has the range down to the last few feet. Even though the roads are generally protected by cleverly camouflaged canvas screens hung on poles, trained observers in airplanes can detect these subterfuges and get sufficient information to enable the roads to be charted with great precision.

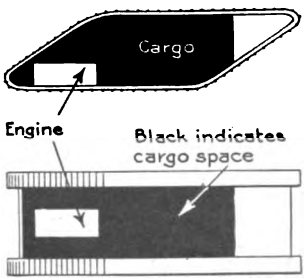


Diagram showing relative space given over to freight

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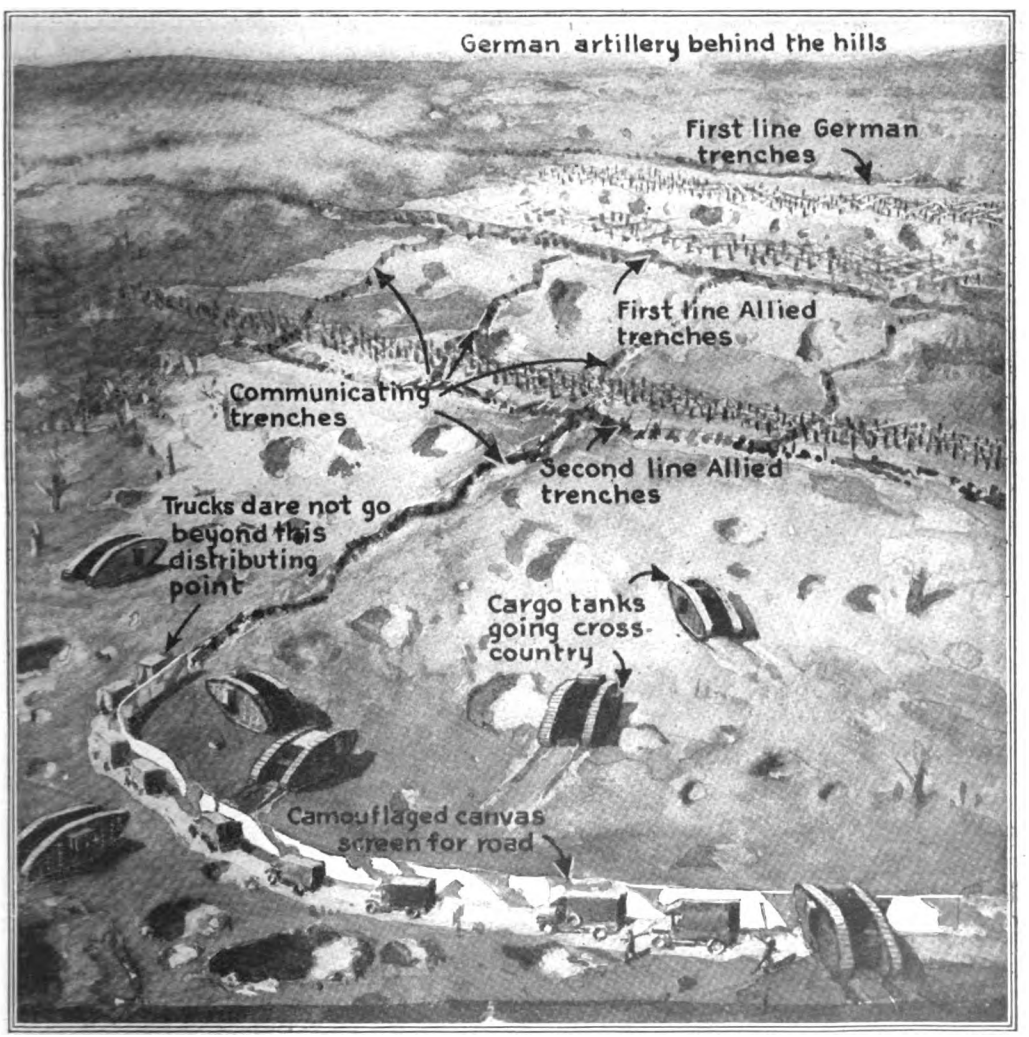
On nights when the enemy has reason to believe that supplies are being brought up, such an intensive fire is rained on these roads that many men, horses and motor trucks are wiped out. Even if there is no slaughter the road is impassable, so that no supplies can be moved forward.

Now comes the cargo-carrying tank, which offers a means of avoiding this great loss. It is not confined to the roads for its progress, but can plow ahead over soft ground, hard ground, and even shell craters or débris which would instantly stop the advance of any ordinary type of wheeled vehicle. To prevent the bringing up of supplies by cargo tanks, the enemy would have to lay down a barrage many miles long instead of concentrating on any certain roads. Such a barrage would be extremely costly, since the cargo tanks could always select a safe sector for their journey. Even if the area in which the tanks are operating were being shelled, there would be no such loss of life as hitherto, since the tanks would be armored only slightly less than at present. They would be immune to rifle and machine gun fire and splinters and could be put out of action only by a



A bird's-eye view of a section of the battle front showing how the cargo tanks would cut across country and avoid the open roads

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direct hit and not necessarily even then, for shells are known to have passed clear through tanks and exploded on the other side without killing one of the crew.

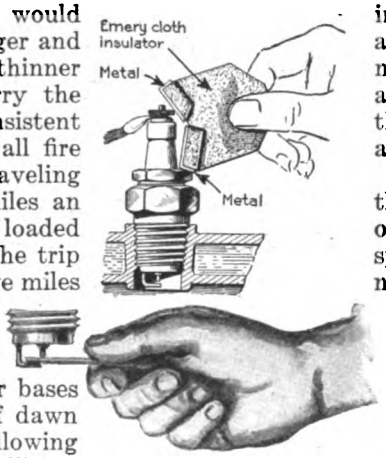
The cargo tanks would not differ materially from the present British tanks in principle. They would probably be a trifle larger and protected with slightly thinner armor in order to carry the maximum tonnage consistent with protection from all fire except direct hits. Traveling at from two to six miles an hour, they could be loaded in advance and make the trip of from six or even twelve miles to the rearmost trenches, be unloaded, turn around and work their way back to their bases before the first ray of dawn was breaking on the following morning. And by utilizing the space usually given over to the machine guns, parts, ammunition and twenty-hours' rations for the crew, regularly carried by the fighting tank, at least five tons of goods, or perhaps more, could be transported by each tank. This is as much as is carried by the average motor truck transport, and as much as by two hundred men carrying fifty pounds apiece.

The illustrations show how British tanks are being actually used to carry supplies on the Western front and how they cut across country where motor trucks would be mired.

Combination Spark Plug Tester and Cleaner

MADE of two heavy pieces of emery cloth glued together at one end with two rectangular pieces of copper inserted between the layers at the other, the handy automobile accessory shown in the accompanying sketches serves the dual purpose of testing and cleaning spark plugs.

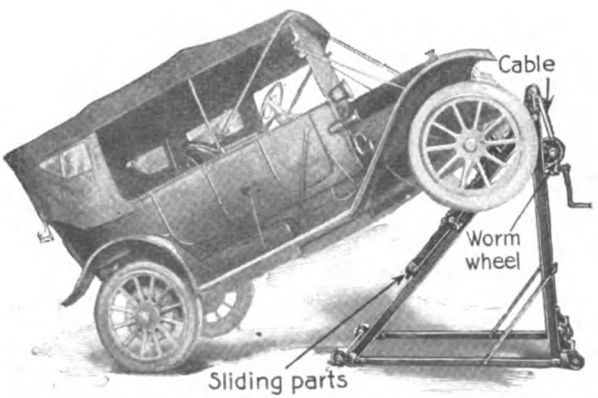
The cloth is cut in a V at the end where the two pieces of copper are inserted. The spark jumps between the inner ends of the two pieces of copper which may be moved closer together or farther apart to determine the value of the spark by the gap it will jump. The cloth end will clean the terminals.

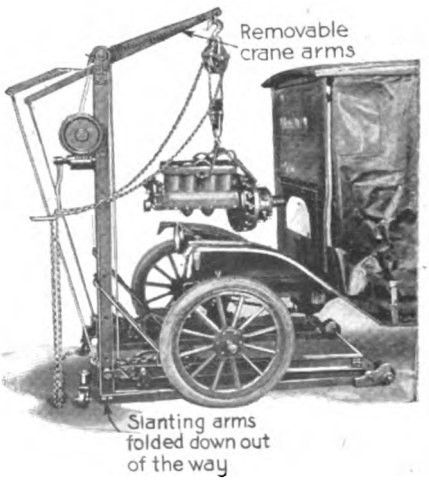


One end of the device is used to test the spark, the other for cleaning terminals

Now It's a Crane and Now a Hoist

WHEN the device shown here is used as a car hoist, the sliding pieces on the arms which engage the car-body are moved up and down by worm-geared wheel operated by a crank. Folding down the slanting arms, and mounting two lifting arms pivoted at the top, changes the device into a crane. It will lift the car off the ground.





Note how easily this convertible crane-hoist lifts the car off the ground so as to make repairs or cleaning easy

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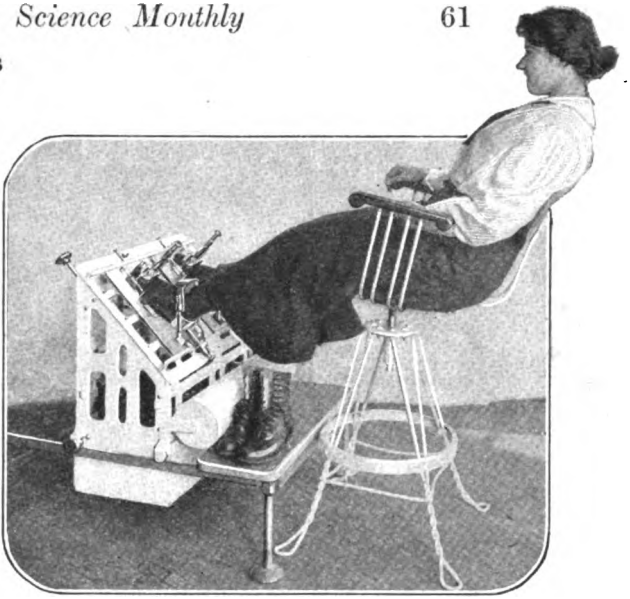
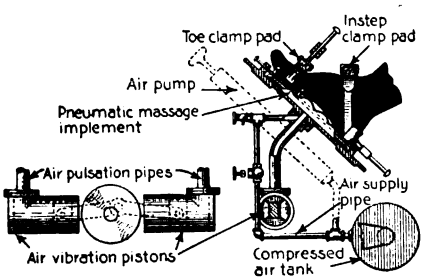
A Massaging Machine Replaces the Hand and Never Tires

AN apparatus that massages like a human hand is designed by the inventor, William C. J. Guilford, of Harrison, Me., to cure fallen arches. The human hand is resistant and yet yielding; it works fast or slow; this machine secures the same effect with compressed air, and varies the speed of operation by means of a motor. Moreover, the machine has the advantage of never becoming tired.

A rubber bag filled with air takes the place of the hand. Pistons which force the air back and forth cause a rapid alternate contraction and expansion of the bag. The feet rest in supports over the bag, the holders having plates at the bottoms with enlarged central openings conforming generally to the shape of the members for which they are designed. If necessary, the width and depth of the plates can be reduced by the insertion of sectional parts. When the bag contracts and expands it comes into contact with the bottom of the sufferer's feet.



A foot-massaging machine that employs a bag alternately contracted and expanded with compressed air



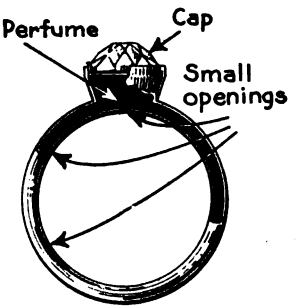
The massage bag is connected by pipes with two cylinders, fed from an air tank regulated by valves

Jewel Perfume Trickler in the Form of a Finger Ring

MODESTY has prevented us from mentioning the fact that now and then we have been vexed to find that the supply of perfume we had taken with us to our office would not last until the day's end. Imagine then our joy and rapture when we discovered that a United States patent had been granted to William H. H. Griffin, a citizen of Goree, Texas, for an invention which meets our case exactly.

Bill has perfected a hollow ring to be worn on the finger, into which the perfume is poured. The inner wall of the ring is provided with one or more apertures which are obstructed to some extent by contact with the finger, so that the oozing of the perfume will be slow and gradual.

The outward appearance of the ring is not different from that of any piece of jewelry worn on the finger, so that the source of the fragrant Aroma de Duck (our favorite) can not be detected. Bill says, "It may be sufficiently large to serve as a bracelet and for other purposes."



This trickles your favorite perfume

Let us suggest, Bill, that you carefully preserve the refinement and dignity of the Trickler. Won't you try to prevent some coarse 'longshoreman from making one large enough to go around his waist so that he may carry his soup in it?

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Can an Airplane Jump Straight Up?

Recent progress in propellers

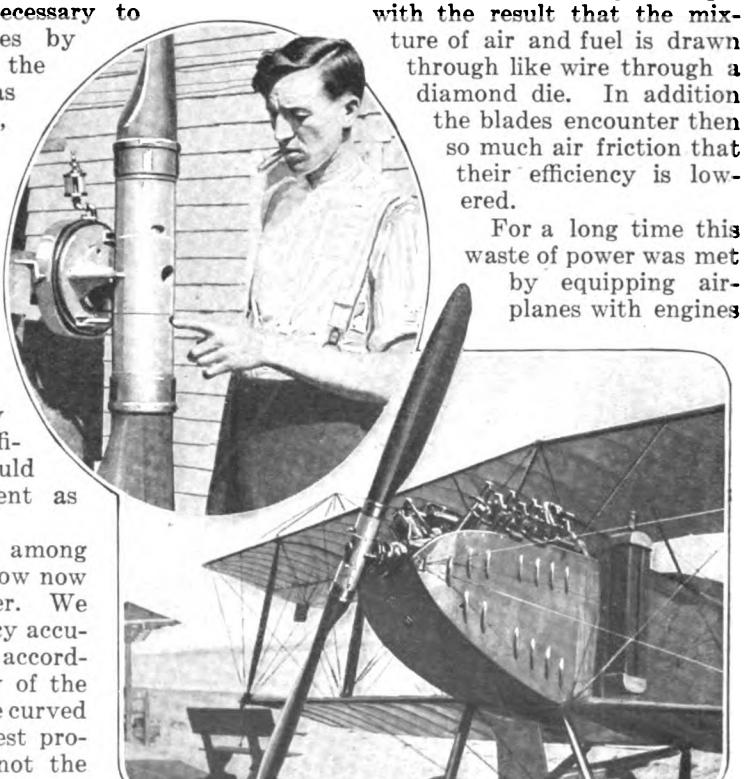
By Carl Dienstbach

IN July, 1905, I had occasion to visit the Wright Brothers in Dayton, Ohio, as the representative of a leading aeronautical journal. At that time the two brothers had finally reached a point where the road to success lay open before them. At first they were rather reticent, but gradually they thawed out and told me many interesting things. One of the subjects that unsealed their lips was the aerial propeller. They waxed warm in denouncing the whole mathematical theory of the marine propeller, which they had studied with great care. Five years later a learned marine architect attacked that same theory with great energy and asserted that propeller efficiency had formerly been altogether a matter of chance. The suction side of the blades was considered negligible and when it was deemed necessary to strengthen the blades by making them thicker, the additional thickness was put on the suction side, as it was believed it would diminish the efficiency of the propeller if placed on the other side. As a matter of fact, only the suction side really counted and the bulging surface given to it by blind chance was the very thing that made it efficient. A true helix would have been as inefficient as a flat plane.

Wilbur Wright said among other things: "We know now how to make a propeller. We can foretell its efficiency accurately. It must be in accordance with the theory of the airplane and must have curved surfaces. But, the best propeller for starting is not the best for flying."

He was right. To be efficient the blades must not strike the air at too steep nor too flat an angle. While the machine moves fast ahead the air resistance to the motion of the blades strikes the blades at an angle, the steepness of which diminishes with the speed of the forward motion, thus practically lowering the pitch of the propeller. At the moment of starting the blades meet but little head resistance and a high pitch, with its steep inclination of the surfaces does not grip the air sufficiently to give the desired pull, in spite of the fact that it consumes much power. On the other hand, the pitch that gives the strongest pull in starting makes the engine race during a rapid flight. An engine with its propeller mounted on the crank-shaft is not designed for maximum revolutions. When it races efficiency falls; the valves are not large enough, with the result that the mixture of air and fuel is drawn through like wire through a diamond die. In addition the blades encounter then so much air friction that their efficiency is lowered.

For a long time this waste of power was met by equipping airplanes with engines



Eustis and his propeller. The lower picture shows the propeller mounted on an arrowhead-type biplane

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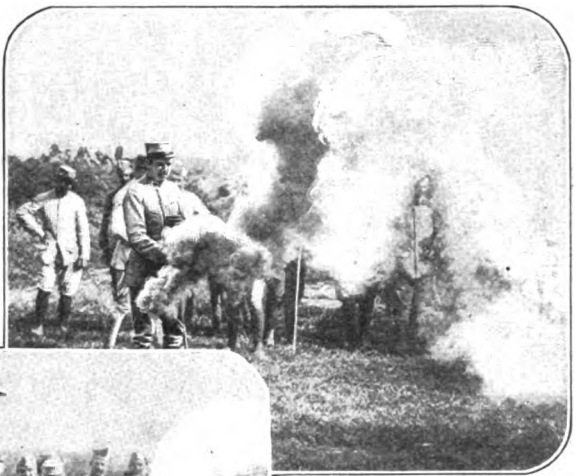
the power and speed of which was constantly increased. Progress in flying has been stupendous, but landing has grown correspondingly more difficult and now requires great skill. The difficulty was felt less, however, as the increasing reliability of the engines made it possible to make landings only in certain places which had been specially prepared for that purpose.

Commercializing the airplane demands first of all greater independence from these large starting and landing grounds which are difficult to procure and expensive to maintain. An airplane must be able to rise from a field sixty feet square.

This can easily be done by making the pitch of the propeller adjustable while in action. If propulsion is twice as strong in starting, the airplane will leave the ground with one-half the length of run. Again, landing on a restricted area is mostly a matter of stopping headway. Any device which adjusts pitch can easily be perfected so as to reverse the pitch when desired. A very low reversed pitch is sufficient to act as a powerful brake without jarring or upsetting the airplane.

There is one special use of the airplane where the ease of landing and starting on difficult ground becomes paramount—the airplane ambulance. Again, the necessity of running an airplane on the ground like an automobile, to get, for instance, from a garage in the city to a field large enough for starting flight, makes adjustable propeller pitch practically indispensable. Adjustable pitch is also of great advantage in climbing and in crossing "airholes." In extremely high altitudes the pitch must be increased to prevent the engines from racing.

The accompanying picture shows adjustable propellers recently constructed by W. I. Eustis and tried with success in actual flight. It still needs development toward reversibility and has yet to prove its durability under hard usage.



Photos © Int. Film Serv.

Making a smoke screen to hide troop movements "somewhere" in France

An officer holding in his hand a smoke cartridge emitting a cloud of smoke

Smoke Cloud to Screen the Movements of Troops

A HEAVY cloud of smoke suddenly made its appearance over the camp of the enemy, completely hiding him from the view of the opposing forces. The section back of this screen was marked by considerable activity. Big guns were being shifted here and there; troops were hastily moving to new positions; reinforcements were arriving by the thousands—and when small rifts appeared in the smoke cloud the enemy was revealed in a stronger position, ready for attack.

Thus is cloud-forming gas employed in warfare. The gas is contained in a tube, and, when released, makes a dense cloud that effectually screens all objects for several yards around. Even the observer in the airplane finds himself baffled when he tries to see what is taking place on the other side of this curtain.

Although the smoke cloud has been described particularly as a means of concealing from the enemy the movements of troops seeking new vantage points, it can also be used effectively in reconnoitering. It is possible for soldiers under cover of a cloud to approach within a short distance of the enemy and escape detection.

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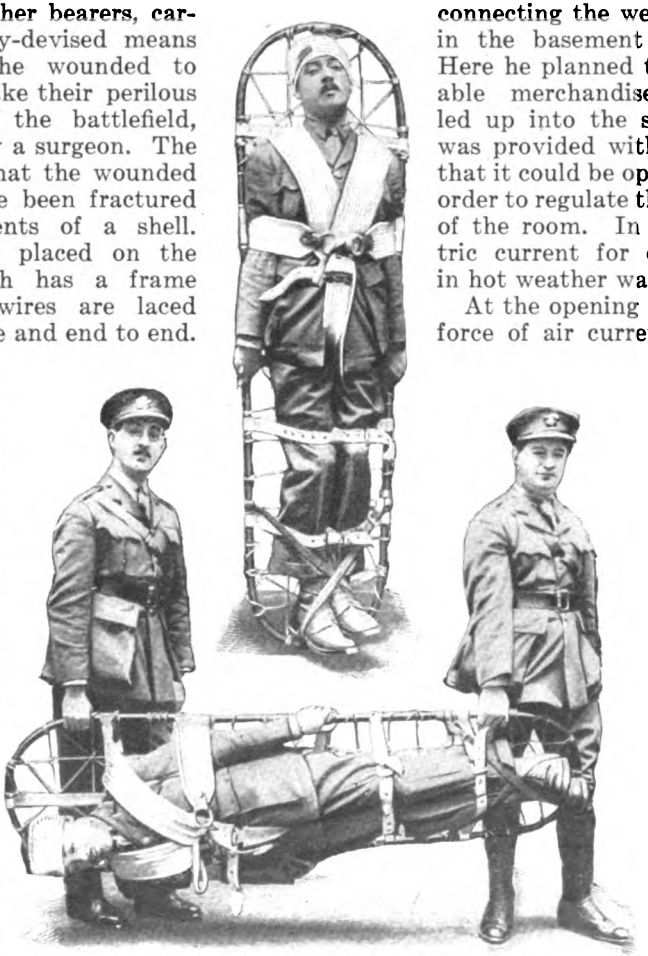
Turn Him Sideways or Feet Up—He Cannot Fall Out

THE new stretcher perfected by the American Red Cross in France is described as superior to any means for carrying the wounded yet brought into use. Draw a mental picture of a soldier found wounded in No Man's Land, his bed of rocks and earth being situated so that it is impossible for an ambulance to approach nearer than a mile. There are two reasons which deter the ambulance drivers from attempting to pilot the vehicle to the wounded man—the impassable condition of the ground and the danger of the ambulance drawing fire from the enemy.

So two stretcher bearers, carrying the newly-devised means for bringing the wounded to ambulances, make their perilous journey across the battlefield, accompanied by a surgeon. The surgeon finds that the wounded man's legs have been fractured by the fragments of a shell. The patient is placed on the stretcher, which has a frame across which wires are laced from side to side and end to end. Straps of canvas and leather are passed about his shoulders, waist, legs and feet, enabling the bearers to carry the patient without fear of his slipping to the ground or causing him discomfort. In this way he is carried to the ambulance and thence to thehospital,located at a safe distance from the continuous pandemonium of the front line trenches.



Photos © Inv. Film Serv.

The employment of this American Red Cross stretcher insures comfort, making a "spill" practically impossible

Building a Home and Business Around a Natural Icebox

THE owner of a plot of ground in western Montana discovered on his property a well which emitted a constant current of cold air which in hottest summer was at about 35 degrees Fahrenheit, the temperature of scientifically regulated refrigerators. With a business eye to economizing in ice he decided to build a house in such a position that the well would be at the side of the kitchen in a built-in addition. In this addition he afterwards placed shelves and receptacles for storing perishable goods

His next step was to build a store near by, with an underground pipe connecting the well with a room in the basement of the store. Here he planned to keep perishable merchandise. The pipe led up into the store, also. It was provided with a damper so that it could be opened or shut in order to regulate the temperature of the room. In this way electric current for operating fans in hot weather was saved.

At the opening in the pipe the force of air current is sufficient to sweep a man's hat from his head. No satisfactory explanation of the current has been found. In winter the air is warmer than the outside atmosphere and prevents the stored articles from freezing.

It would be a good idea to explore this remarkable well and see if it does not lead to a large cave in the bowels of the earth.

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Talking Gloves for the Deaf and Blind

The system of talking through gloves, as devised and used by Dr. William Terry, is explained and illustrated by a diagram

WHEN the war is over how many thousands of men will be deaf or blind-and-deaf? They must be kept in touch with the world about them. This can be done by a very simple means—the use of a touch alphabet system with a so-called "Talking Glove."

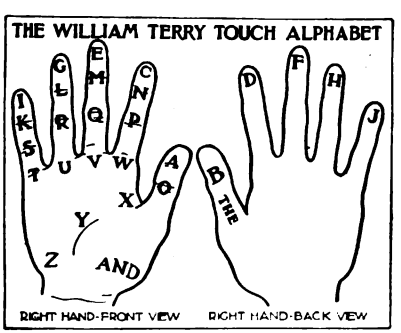
The basic principles of such a system are: (1) The arranging of the letters of the alphabet upon the hand in such an orderly manner that they may readily be memorized by the deaf or deaf-and-blind person. (2) The marking of these letters with indelible ink upon a white glove, so that any "speaker" even though unfamiliar with the glove can touch the marked letters, as he would the keys of a typewriter, and thus carry on a conversation.

Dr. William Terry getting the current news through talking gloves which he had devised

Dr. William Terry of Ansonia, Connecticut, has invented a system which is being widely adopted.

Dr. Terry lost his hearing as the result of the strain and exposure incident to his duties as a surgeon in the Civil War, but continued in the active practice of his profession for nearly forty years thereafter, until at the age of seventy he became totally blind also. At the age of eighty-two he wrote as follows:

"I found myself a dozen years ago in what the wonderful Miss Helen Keller calls the valley of two-fold solitude, totally deaf and blind. I could converse with no one and had to invent a system of touch alphabet for the hand, which by the use of a marked glove, has enabled me to enjoy the benefits of conversation. . . . By it I have been kept well informed on current events and in sympathy with the rapidly advanced and ever advancing philanthropy and Christianity of our blessed times."



The system devised and used by Dr. Wm. Terry for many years

No stronger evidence of the value of "Talking Gloves" could be found than the experience of two other deaf and blind men, each of whom worked out and used a touch alphabet for many years. Morrison Heady, of Louisville, Kentucky, used a talking glove while he was between the ages of forty and eighty-six years, frequently wearing it on the street, so that children could talk with him.

Henry G. Stephens, of Stratford, Connecticut, whose loss of sight and hearing was the result of three years of brave service in the Civil War, used a glove for thirty years. A knowledge of the Terry System is being spread among those in England, France, Belgium, Canada and the United States who are aiding men injured in the war, accounts having already been published in English and French and also in raised type.

Pamphlets describing the system will be sent free by Harold T. Clark, 1201 Leader News Building, Cleveland, Ohio, on request.

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These beautiful terns somewhat resemble the gulls, but are smaller. Graceful and delicately colored as they are, such a flock as this presents a fine picture. Note the eggs laid in the sand

Royal Terns Caught by the Camera When They Were Not Looking

THE charming scene shown in the picture was taken on a small island near the entrance to Winyah Bay, Georgetown, S. C., and shows a large colony of royal terns at their breeding-place.

The royal tern inhabits the tropical and temperate parts of America. It is found principally along the coast, but occasionally also in the interior, as for instance, in Nevada and in the region of the Great Lakes. This unusually pretty bird breeds in large colonies along the Atlantic coast, from Texas to the Middle States. The females build no nests, but lay their eggs, from one to three in number, directly in the sand. The eggs are yellowish drab or creamy in color, sometimes almost white, and show irregular blotches ranging in color from dark umber to purplish. The terns resemble gulls in appearance and habits, but are smaller and more graceful, making quick dashes into the water when hunting for food.

Our Earth Has Had Many "Glacial Periods" or "Ice Ages"

ONE often hears of "the glacial period" or "the ice age" of the earth but, strictly speaking, this expression is not correct. It is now established beyond all reasonable doubt, that this planet has experienced not one but a great many glacial periods. Evidence has been found which proves that the latest or Pleistocene glacial epoch had several important subdivisions and that all of the present continents have experienced glacial epochs at different ages. Great ice sheets were formed at different periods back to the Proterozoic age, that is, the age of the oldest known sedimentary rocks, a great many million years ago. One of the most recent discoveries of old glacial deposits was made by Prof. W. W. Atwood, of the U. S. Geological Survey, near Ridgway, in southwestern Colorado. These deposits were found beneath tertiary lavas of the San Juan Mountains and resting upon Upper Cretaceous beds. They have, it is believed, been formed in early Eocene times.

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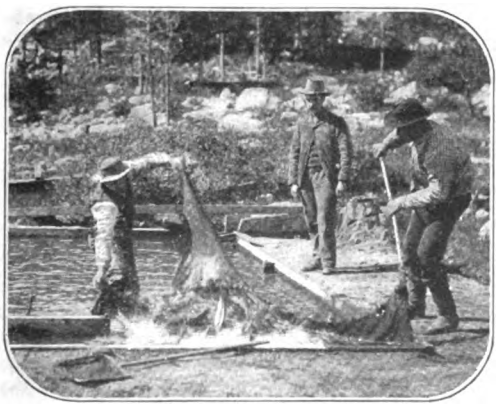
Raise Fish On Your Farm

The crappie and the sunfish become farm creatures like the horse, the hog and the cow

A fish pond on an up-to-date farm. Patriotic and thrifty farmers will raise fish to increase the food supply and incidentally share Mr. Hoover's burden

AN up-to-date farmer has a fish pond, just as he has a chicken yard or a pig pen. Fish can be grown and propagated in natural or artificial ponds, and the quantity of food they furnish should stimulate every farmer in America to have his own little fish preserve.

The chemical compound known as protein is an essential requirement of the human body. In the past we Americans have derived most of our protein from beef, mutton, and pork. But since the war has raised the price of all kinds of meat we must look to other sources for our supply of protein. Now—it has been proved that, pound for pound, fish contains as much protein as meat, and in some cases more.



No question about this big "catch" of fresh water "beauties"

Fish, adapted to culture on farms are the spiny-rayed or warm water variety. Ponds intended for fish may also furnish water for stock and its overflow utilized for irrigation purposes.

Several important points must be borne in mind by the prospective pisciculturist. There must be a constant supply of fresh water from springs or brooks and an outlet to drain off all surplus water. He must also make the bottom of the pond water-tight, so that a small inflow will be sufficient.

A layer of mud lining the bottom for the growth of aquatic plants, will grow food for the fish.

The fish best suited to pond culture are the different varieties of fresh-water bass, the crappie, the sunfish and the catfish.

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The Acrobatic Air-Fighter

How the fighting Airplane is designed to meet the demands of the turning, twisting, tumbling air duellist

By Ottorino Pomilio

The illustrations accompanying this article are reproductions of paintings by Lieutenant H. Farré. The author of the article is one of the leading airplane designers of Italy.—Editor

FIGHTING in the air begins over the drafting board of the airplane designer and in the aerodynamic laboratory. Duelling with machine-guns at a height of 20,000 feet is the last phase of the struggle in which two "aces" engage. Unless the designer has produced the best possible type of machine, unless the laboratory tests have demonstrated that his creation is likely to be better than anything previously produced, an air duel may be lost.

What should be the characteristics of the fighting airplane? Of course, it should be fast, faster, if possible than the corresponding type of the enemy, and it should be a speedy climber. And yet swiftness and climbing ability are not its most important characteristics. Ease in executing the most audacious acrobatic feat is an accessory characteristic, it is true, and yet the machine that is not an acrobatic contrivance is worthless. Even armament, however powerful, loses enormously in effectiveness if the pilot cannot loop-the-loop, spin tail first, or slip sideways in safety.

An Air-Fight Graphically Described

A famous Italian "Ace," Major Principe Ruffo di Calabria, thus describes the tense moments of an attack and fight in the air:

"You approach the enemy machine from the rear with the speed of a meteor, at three or four hundred yards. Your forehead pressed against the front head-rest, your eye constantly at the telescope, you sight at the target and imprison the image of the enemy machine within the crosshairs of your telescope, a malignant insect caught in a net from which he cannot escape. You rise; you fall; you turn to the right, to the left; always you keep your telescope on the enemy. Not the hand, but the mind guides the machine. Although no straight line of flight is followed in your efforts to out-maneuver the enemy, you feel as if you were being dragged by an invisible wire—the line of sight. It all takes but an instant. Instinctively you press the trigger. Four or five shots and the faithful pellets have hit the target. They are tracer bullets; you can see the trail they leave. The enemy machine falls to the ground, perhaps aflame.

"Often you are counter-attacked. You escape; you attack again; you loop-the-loop, you hurl yourself about in spirals. All these maneuvers are always instinctive. Your mind alone guides the machine, obedient to the slightest touch of the controls. Thus your attention is not distracted. The control in your hand is like a light foil in the hands of a skillful swordsman. His will directs the point of his weapon, which flashes through the air exactly as if it were his projected thought. Woe to the pilot whose machine is sluggish in responding to the action of the controls!"

My object in quoting these words of a master of air-fighting is to fix the attention of the reader on the importance not only of speed, but of handiness, as an essential characteristic of a fighting machine.

The pilot of a fighting airplane must possess qualities akin to those of his machine. And they are? Extraordinary sensitiveness and that "finesse" of style, which in American slang is aptly termed "class." Such a remarkable pilot is not an acrobat by habit. To him an acrobatic trick is merely a tactical maneuver.

The problem of creating a new type of acrobatic machine is much more difficult to solve than appears at first sight. As a designer I cannot stop with an existing type. More powerful engines are being developed every day; new and more difficult exigencies of war constantly arise which must be considered in designing and building a new fighting machine. The designer must constantly outdo himself in order to keep the upper hand of an enemy who is naturally trying to outwit him.

Man's Limitations Must Be Considered

The designer encounters ever-increasing difficulties. He has to cope with a factor which may be considered as constant. That factor is man, his physical strength, his ability, his sensitiveness, all limited. Constantly confronted by the human factor, the engineer is taxed with the problem of designing a machine as docile and as easy to control as a less power-

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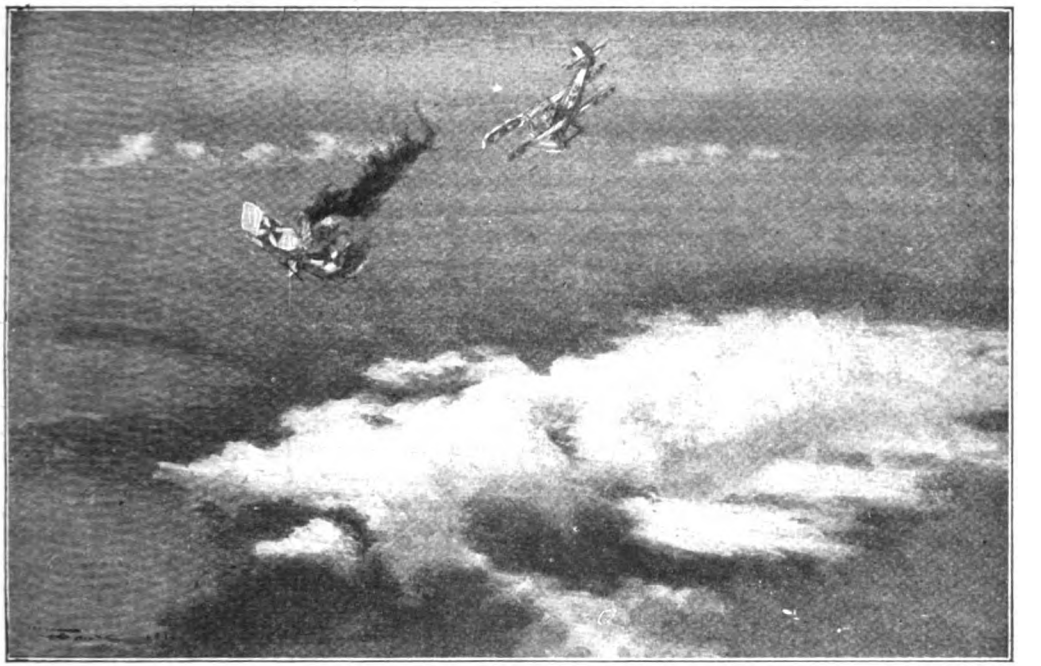

"It all takes but an instant. Instinctively you press the trigger. Four or five shots and the faithful pellets have hit the target. . . . The enemy machine falls to the ground, perhaps aflame"

ful and therefore lighter airplane, and yet exceedingly fast and enormously strong.

Limitations are also imposed by speed. It is not difficult to make a machine fly at even two hundred miles an hour, but it is very difficult to land at high speed. A pilot cannot slow down to the same extent as a motor-car driver. There is a minimum beyond which he cannot go. This minimum, then, is a serious limitation which cannot be ignored. It is evident that nerves can transmit sensations so fast and no faster. We must be guided by what the best pilots tell us on that score. Landing at too high a velocity is dangerous, even on perfectly level ground. By too high a velocity is meant a speed of about seventy miles an hour. Although a field may be level, even a tuft of grass constitutes an inequality that makes itself felt when landing at high speed. Such slight inequalities form veritable obstacles, when the rolling speed of the wheels is high. A pebble will cause a racing automobile to leap into the air. And so it is with a flying-machine on a grassy field. Hardly perceptible indentations may result in disaster.

The Future May Bring Greater Speed

It is not impossible that in the near future, when specially constructed aviation fields will be numerous, when even acrobatic feats now performed only by the exceptional pilot will be performed by every flyer, the limits of minimum speed will be much higher than they are at present.

Besides the difficulties thus far considered, other conditions are imposed on the designer by the exigencies of war. The armament of a fighting airplane must be perfect. In fact, the machine must be considered as being nothing less than an animated weapon. Only then does the fighting machine become a terrible instrument.

The necessity of installing the guns so as to be readily accessible in a jam, and the desirability of locating the ammunition in a convenient place, offers the disadvantage that however we may try to minimize the head resistance by covering the guns with streamline hoods, the propeller shape of the fuselage essential to maximum air penetration is spoiled. To attain high speeds any irregularity of

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shape, the slightest discontinuity in the surface of the fuselage means a loss in power. Evidently it must be left to the ingenuity of the constructor to reduce these losses to a minimum.

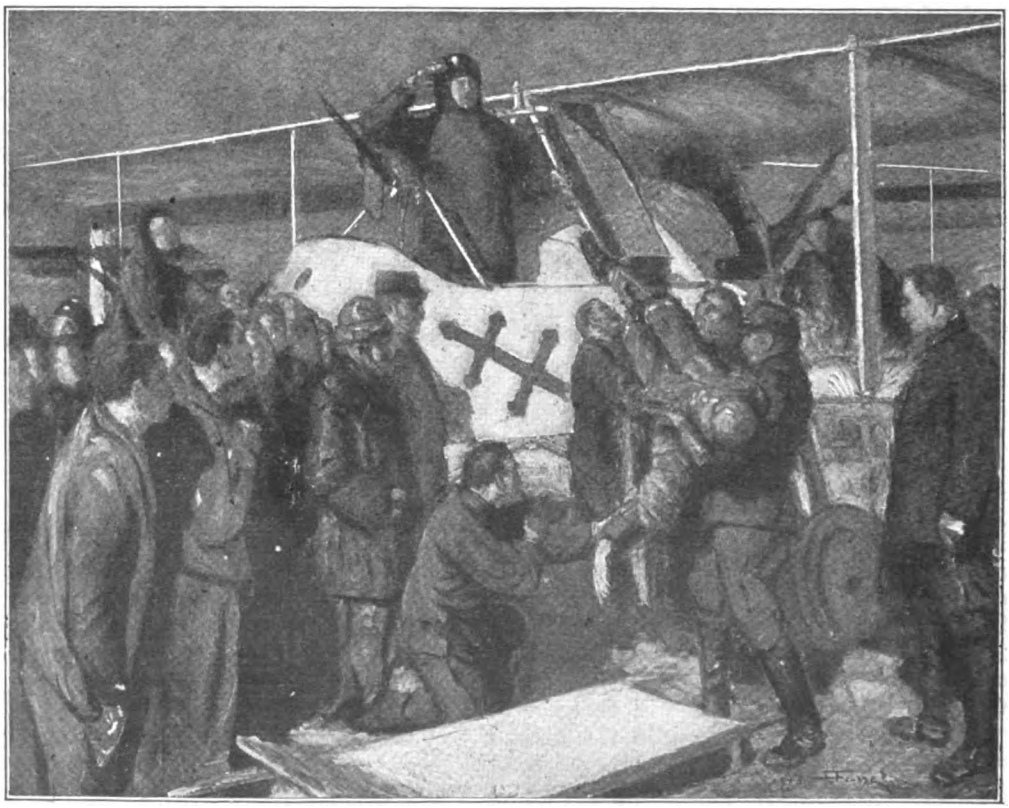
Other Obstacles to Speed

Another obstacle to increasing speed is the fact that the military pilot (and the fighting machine pilot especially) must have a wide angle of vision. The ideal shape for minimum head resistance is again spoiled, and more power is wasted.

This is not all. The fighting airplane must possess high climbing speed and must be able to reach altitudes greater than those attained by other types. To top his difficulties, the designer must produce a machine which will be enormously strong for its weight.

The strains to which a fighting machine is subjected while performing acrobatic feats or making quick turns at high speeds are enormous. Forces of considerable magnitude come into play in the rapid, violent movements required of a fighting airplane. The pilot himself can feel the increase in the normal stress in the whole machine as he twists and turns. These stresses, caused by a thousand rapid and violent changes in position and direction of the flying machine, are all controlled by the light and almost imperceptible pressure of the pilot's hands and feet on the controls.

In types of airplanes not used for fighting, more latitude is given to the designer. The good qualities of the machine may vary more. The lower limits are simply those tolerated by pilots. On the other hand, the fighting machine must always be perfect. If it lacks one of the characteristics previously pointed out the pilot cannot act effectively in an attack, which, in its most terrible moment, is a single masterly maneuver in which a dozen movements are inextricably merged, movements as subtle and swift as those of a cat.



The Supreme Sacrifice

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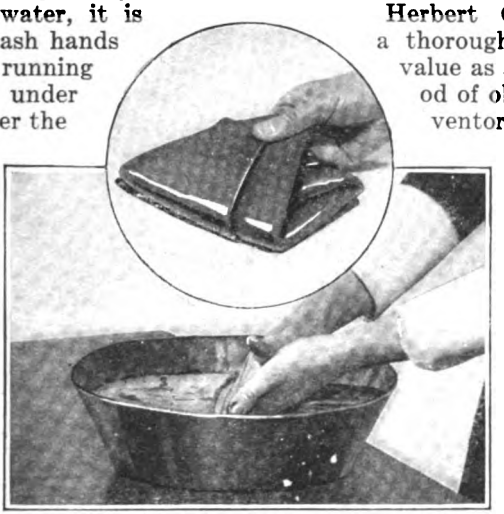
Don't Wash Under the Faucet. Carry a Washbasin with You

WHEN the plug in the hotel wash-basin is a minus quantity and the basin will not hold water, it is quite a struggle to wash hands and face from the running faucets, dipping first under the hot and then under the cold. It may be even worse—they may be spring faucets!

Welcome, then, the collapsible india-rubber wash-basin. It is of generous proportions when opened out, but can be folded into a compact parcel that can be slipped into one's valise. Or, if you are a mere man, you can carry it in your coat pocket. It is all right for a woman to transport it in her knitting bag as she goes about for business or for pleasure.

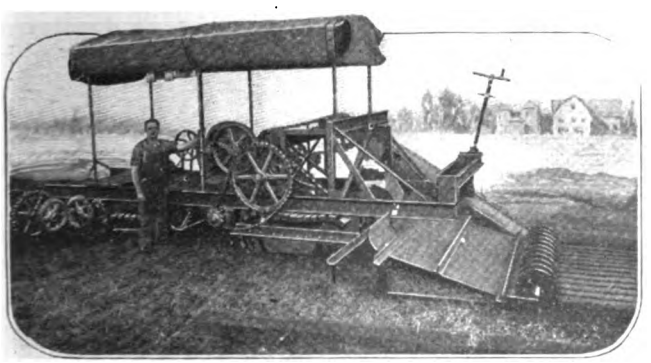


A wash-basin of rubber, which can be folded and carried in your coat pocket

Machine That Digs, Grinds and Blocks Peat

THE growing scarcity of coal has brought many heretofore neglected fuel substitutes, such as lignite and peat, into prominence recently. In parts of Europe peat is used extensively as a fuel; the peat bogs are considered a valuable asset. In America there are many localities where peat forms rich deposits, but heretofore little attention has been paid to it as a possible substitute for coal. This condition is likely soon to undergo a complete change and the beginning has already been made.

Herbert Garnett, who made a thorough study of peat, its value as a fuel and the method of obtaining it, is the inventor of an interesting machine, which is shown in the accompanying illustration. The machine, attended by one man only, travels over the surface of the peat bog, digs, grinds and lays out the raw peat in one continuous and uninterrupted operation. No hand labor is required until the dry fuel in small blocks is ready to be loaded into wagons for shipment to market. The complete drying of the peat requires from four to eight weeks. The machine is propelled and operated by a gas engine or an electric motor and is said to have a capacity of three to five tons of dry peat an hour at the cost of only one dollar a ton, according to the inventor.



This machine produces from your bog from three to five tons of peat an hour at a cost of one dollar a ton

Potato Butter to Reduce the Cost of Living

FOURTEEN ounces of mashed potatoes added to two ounces of butter will produce one pound of a very palatable butter-substitute. It can be colored to improve its appearance, and if kept for any length of time it should have added to it some butter preservative. A pound of potato-butter will cost only about ten cents. There are butter substitutes now sold that are wholesome and, when colored, can hardly be told from real butter. But this is the cheapest yet that we have any knowledge of.

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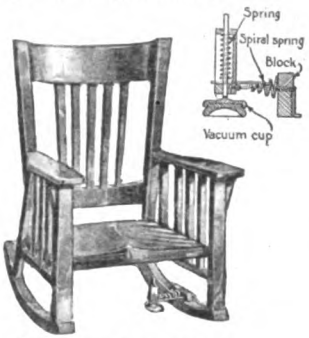
Housekeeping Made Easy

Mop wringer attached to the mop handle makes wringing easy and agreeable

This measuring spoon is made by halving a spoon longitudinally

Reading table for an invalid unable to hold a book



A vacuum cup prevents the chair from creeping

New design for a table cabinet made in metal and adorned with white enamel

Sandwiches can be arranged around the edge of this serving dish

A laundry bag with a lock designed as a protection against theft

A rustic design for flower holders, made in cement

Dolls made of sponge make washing a joy and not a task for the little ones

Needles made for the comfort of the knitter in close quarters

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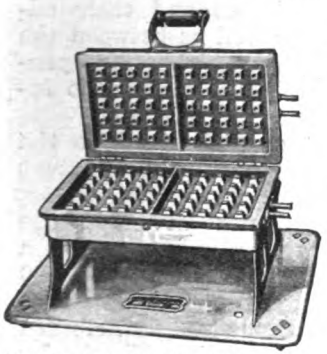
Housekeeping Made Easy

Small home canners are a help in preserving fruits and vegetables

A holder for boiling six "newly laids" at a time

This waxing and floor polishing machine will prevent many a backache



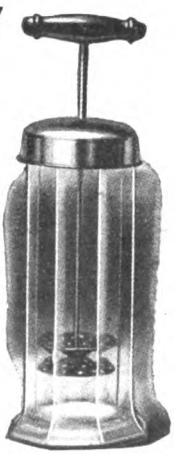
Waffles can now be made on the breakfast table with this electric iron

A fireless cooker and its numerous parts which are heated by electricity

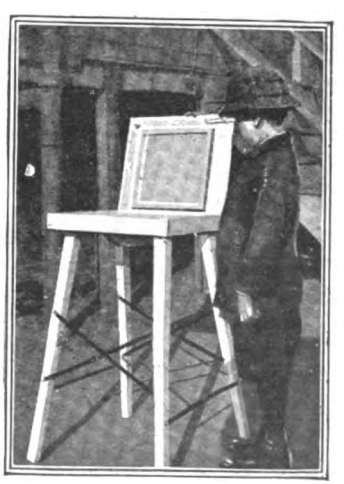
Syrup cup holder that cuts syrup off without any spilling

At the left is shown a strainer that fits on any pot or pan

A neat and convenient holder to keep the twine ball ready for use



Small hand churn for "stretching" butter by working in milk



A folding stand for holding the wash basin in camp

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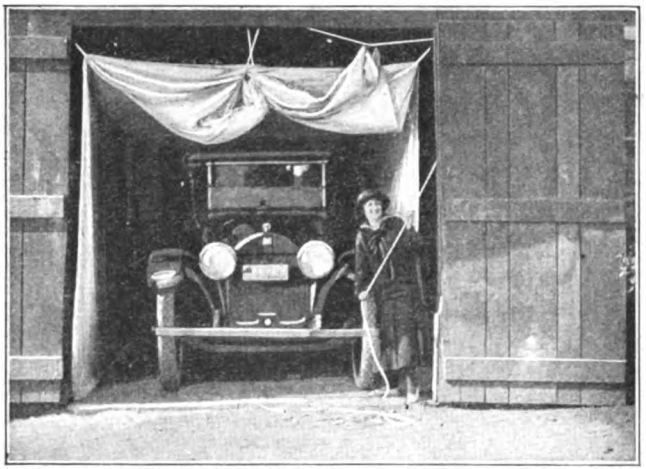


The front of the tent is rolled up by a pulley system. When let down, the car is wholly protected against dust

Converting the Old Barn Into a Dust-Proof Garage with a Tent

HOW, by means of a tent, to convert an old barn into a very serviceable garage has been demonstrated by Herbert C. Goudge, a Los Angeles lawyer. When Mr. Goudge's horses were supplanted by gasoline, the stable had to house the car. Because the stable was anything but dust-proof, the car had to be cleaned very frequently. Mr. Goudge, therefore, conceived the idea of the tent shown in our illustration. This contrivance works admirably, keeps the car clean, and saves a lot of bother.

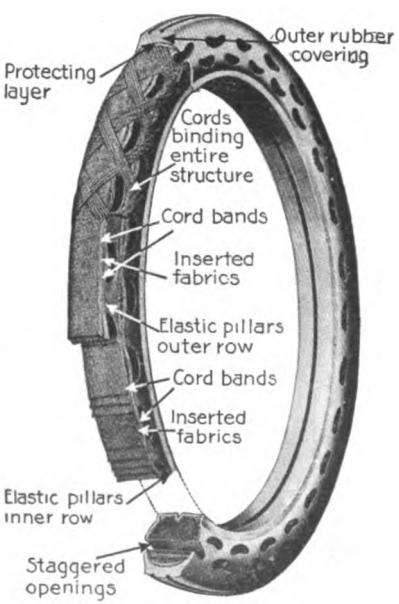
This Tire Is Built to Stand Strain

A TIRE that lays claim to many points of superiority over ordinary tires—whether pneumatic, solid, or of the so-called cushion variety—has been invented by three men of Roanoke, Virginia: F. A. Krusemark, L. G. Funkhouser and H. G. Carpenter. It is up-built of rubber, cord, and cord fabrics, and in its construction the principle of suspension is applied so as to utilize both the elastic and the resilient properties of the rubber.

Look at the accompanying illustration and you will see that elastic pillars rearranged around a base are tightly bound in place by encircling bands, and that around these bands are again arranged an outer row of elastic pillars staggered with relation to those of the inner series; these outer pillars are likewise secured by bands. Staggered openings penetrate the whole tire, and between the outer bands and their adjacent openings, as well as between the inner bands and their neighboring openings are inserted fabrics tending to increase the resistance of the bands.

The staggered openings increase the inner radiation surface to such an extent that heat is reduced.

The encircling bands—seven in the inner and six in the outer layer—have a combined tensile strength of 35,600 pounds, and a lateral strain, exerted by the car and its load, is evenly distributed throughout the tire by these bands. The interlaced cords, running spirally in series of five around the entire structure, have a tensile strength of 600 pounds each, or 3,000 pounds to a series; and since at least six of these series receive and distribute any lateral strain encountered, a total lateral resistance of 18,000 pounds is the support given by the body of the tire. The combined resistance of the encircling bands and the interlaced spiral cords takes care of the traction strain to which the car is subjected when the power is turned on the wheels.



This tire is built to withstand strain better than the common tire

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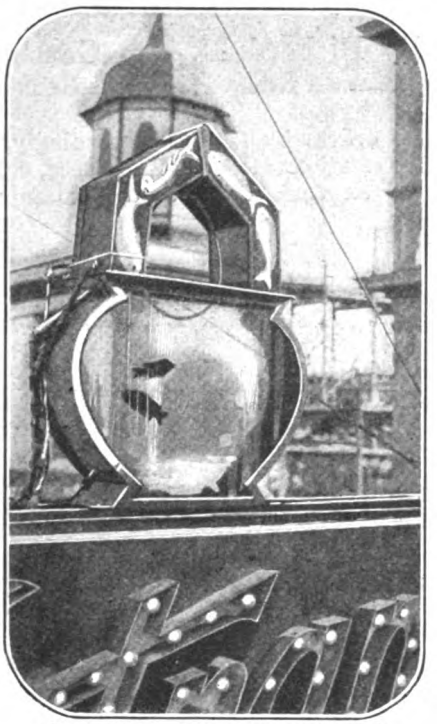
Live Fish Used to Advertise Fresh Fish Dinners

THERE is no limit to the enterprise of advertisers. The cafe owner of a beach resort in California showed originality in his advertising method, when he had the aquarium shown in the illustration placed above the cafe sign. In the aquarium, which has a glass front and back, two live sea bass are kept, which, by their lively movements in the clear water, attract more attention than any ordinary sign. The fish are supplied with fresh sea water and fed at regular intervals.

The water is conveyed to the aquarium by means of pipes. The live fish give the impression to the prospective diner that only fresh fish are served.



Cooked fish advertised by live fish in an aquarium above store sign

Making the Automobile Mow the Golf Course

BY combining an old horse-drawn lawn mower and a second-hand automobile an inventive member of a golf club in South Bend, Ind., produced a machine-power mower which has since proved highly effective in keeping the golf club's fairways in excellent condition.

The front wheels of the automobile were removed and the front part of the machine was so attached to the lawn mower as to rest upon its broad-tired wheels. Large tractor wheels were substituted for the rear wheels of the automobile.

This thoroughly efficient lawn mower with machine power was made by combining an old mower with an old automobile

Soldiers Use "Duck Boards" to Avoid Taking Mud Baths

WHEN the Allied forces in Flanders are not battling with the Germans, they are trying to outwit nature. This is the substance of a report brought back from the firing line by Major General Charles Clement, U. S. A.

Mud was a source of considerable annoyance to the soldiers. So the engineering force of Australia devised what has become commonly known as the "duck board," but which the Canadians have named the "bath mat," both being terms of derision.

The board is made of a number of small strips of wood, fourteen to fifteen inches in length, which are nailed to stringers placed in front of one another and extending for miles. A step off the "duck board" means a plunge into a sea of mud, at least three feet in depth.

The "board" was devised to enable the Australians to attack the Germans more successfully, and it served to provide a path to victory.

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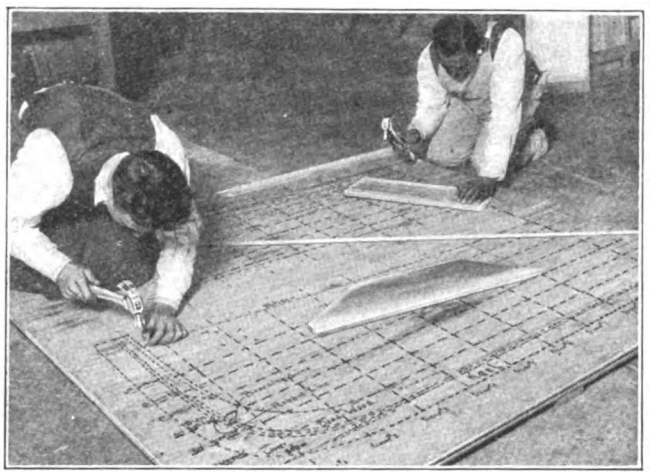
Making Boat Builders Out of Carpenters

The failure of the old-time apprentice system leads the Pratt Institute to devise a new plan of training shipwrights

By Richard M. Van Gaasbeek

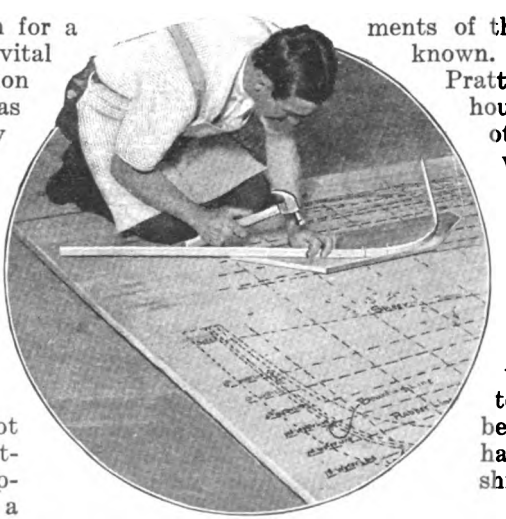
School of Science and Technology, Pratt Institute, Brooklyn, N. Y.

THE placing of huge orders by the Government and the erection of new plants have created an extraordinary demand for skilled labor, so much so that the United States Emergency Fleet Corporation is straining every effort to obtain an adequate supply of skilled men for ship and boat building. To assist the Government in meeting the labor situation a practical course designed to fit workmen for a line of work that is of vital importance to the nation at the present time has been inaugurated by Pratt Institute.



Men at work on the mould loft floor, picking up the lines of a vessel. This calls for a knowledge of descriptive geometry requiring much special study

Such a course is all the more necessary because the old-time apprentice system has failed. The cost of trade training to the shipbuilding industry is almost prohibitive. A concern which pays not a penny for training attracts the trained apprentice by offering a little more than the standard wage.



The bending of battens makes great demands upon the skill of the carpenter

Accordingly, an employer must, in self-defense, cut down the cost of training to a minimum. To do this, he must exploit the apprentice to such an extent that the cost of training is fully covered.

The war has brought the schools and the shipbuilders in closer touch. The possibilities of the schools are being demonstrated and their usefulness in this direction will increase as the requirements of the nation are made known.

Pratt Institute gives to house carpenters and other skilled woodworkers a practical understanding of wooden ship and boat building. The course is open only to experienced wood-workers in the trades mentioned and is intended for men just before or just after they had been transferred to ship or boat work.

Mr. Joseph F. Reardon, master boat-builder in the Brooklyn

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Navy Yard, organized the class. When the demands on his time at the Navy Yard became so great that he was unable to continue as an active instructor Mr. Rassiga, Jr., Quarterman in the Brooklyn Navy Yard and Mr. Edward Weber, also connected with the yard, assumed charge of the class, carrying out many of the ideas suggested by Mr. Reardon.

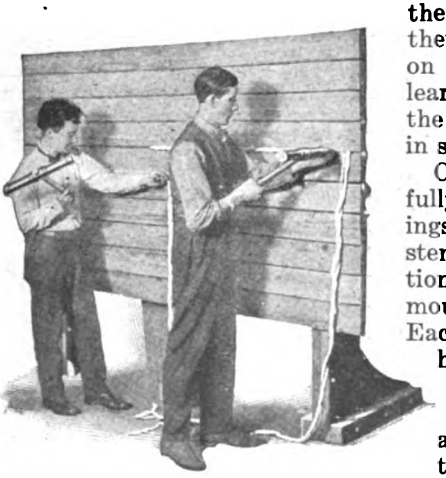
The outline of instruction given consists in such practical work as taking up moulds from mould loft floor, lining scantling from moulds, the construction of center frame, including stem, keel and stern, cutting rabbets, erecting transverse frames, scaling, beveling and installing planking, scarfing of planking and longitudinals, caulking (light and heavy work), installation of longitudinal clamps, deck framing, methods of laying decks, and plan reading.

A group of workers fairing up their moulds

Scarfing timber with an adze. It's not as easy as it looks

As a model a twenty-four foot power-boat was selected because it seemed to lend itself best to teach men how to build submarine chasers and smaller craft as well as larger ships. The fundamental principles involved in boat and ship work are very much alike. The lines are laid down on the mould loft floor, the lines are taken from the floor, the moulds are made, the bevels are developed and applied, the planking is beveled and installed in similar ways in both boat and ship work.

The illustrations give some idea of the work already accomplished by this class. Two pictures show men at work on a section of the mould loft floor. Laying down the lines of a vessel on the mould loft floor calls for a knowledge of the principles of descriptive geometry. It is not an easy task for the house carpenter to think in terms of boats or ships. He must have some idea of the construction and be familiar with plans before he can undertake the job of laying down the lines on the floor. The lines in these illustrations are laid down as a class problem under the guidance of the instructor. While they complete their parts they compare their work with the lines on the floor. Thus they learn to grasp many of the principles involved in ship and boat work.



Practising the art of caulking on a form soon makes a man efficient

On the basis of carefully made working drawings the details of the stem and stern construction are laid down on the mould loft floor full size. Each man must pick up his lines from the floor, make his own moulds and get out all the various parts of the vessel from start to finish. This demands painstaking care.

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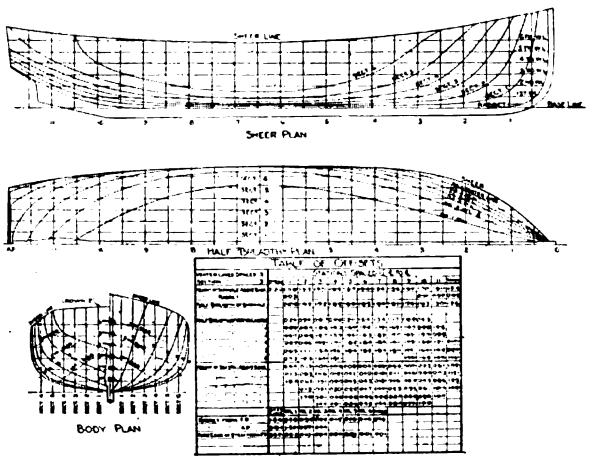
Each man in turn is given individual lessons in caulking and an opportunity to practice on the form. This form is built of heavy stock and resembles the side of a ship. A lighter form is bolted on the face of this form from time to time, and instructions are given in both ship and boat caulking. Only a few principles underlie the art of caulking, and these can be taught by the instructor in a very few minutes, so that what the men actually need is an opportunity to practice and thus gain a little confidence in themselves before tackling the real job. A house carpenter hesitates to start in a new field of work. For the most part, the men are glad to practice on a form of this kind, with a few suggestions now and then from an expert, even at the cost of a few blisters on their hands. The heavy form is first caulked with cotton and then oakum. The lighter form is only caulked with cotton.

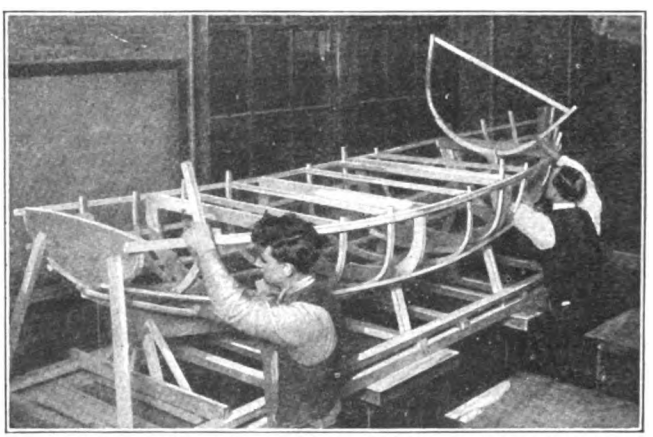


Tracing showing moulded lines and offsets used in the shop during the construction of these boats

A group of men are shown scarping with an adze and splicing two yellow pine timbers together. The adze is a tool that a carpenter seldom uses and knows very little about. It takes considerable skill to handle it properly and to be able to cut to a given line. Some of the joints made by the men in this class would be a credit to men of longer experience.

Then are shown the offsets and developments of the moulded lines in the sheer, half-breadth and body plans. The men are shown how to apply these offsets, how to fair up their lines after locating points and how to develop their bevels from the diagonal lines shown on the body plan and how to apply these bevels on their frames.

In another picture the frames are being fastened in position. These frames are made of oak, steamed



Fitting and erecting frames. They are steamed and bent on the form, then removed and shaped

Showing the installation of sheer or upper strake, a job requiring great accuracy as well as mechanical skill

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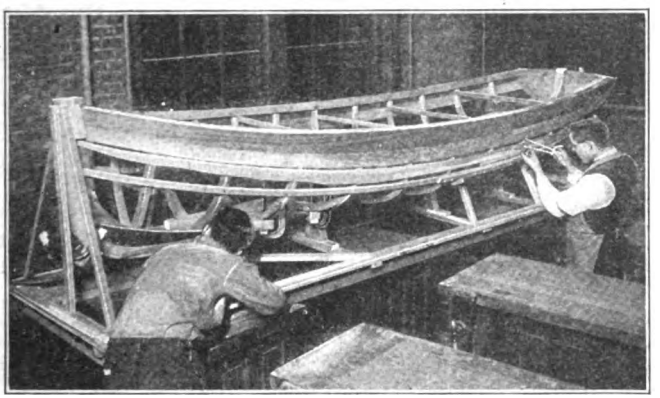
and bent on a form in double thicknesses. After removing them from the form, they are re-sawed, paired (right and left), beveled, shaped and fastened in position. The ribbons are bent around false frames and faired up. These hold the lines of the boat until after the planking is installed, the ribbons being removed as the planking is fastened.

The upper or sheer strake and the second or binding strake are shown in position. The spiling batten is now being bent for the purpose of obtaining the shape of the next strake. It is necessary to get the proper shape of the planking before bending, so that when bent it will fit around the frame without springing or bending it.



Taking the spiling for the first lower strake and fastening down the garboard on the port side of the keel

Pratt Institute is trying to give to house carpenters and other woodworkers an experience that will give them the necessary confidence in their own ability, so that they will enter their new field of activities with some degree of assurance and not be afraid of the task set before them.

The following list of tools was compiled to give the men some idea of the tools used in the boat-building industry:

Claw hammer, crosscut saw, rip saw, panel saw, compass saw, ball pean hammer, adze, (lipped), spirit level, ship-carpenter's bevel, plumb bob, auger bits, one-quarter to one inch; extension bit, smoothing plane, jack plane, fore plane, bilge plane, compass plane, baller plane, wood reamers, one-half to one and a half inch; wood gouges, one-quarter inch to two inches; draw knife, caulking irons, caulking mallet, wood rasp, oil stone, cold chisel, cape chisel, spoke shave, ratchet brace, steel square, tri-square, seven and one-half inches; compass, hack saw, end-cutting pliers, marking gage, wood chisels, one-quarter inch to two inches; burr set, pinch bar, twenty inches; slice chisel, two- and one-half inches. There may be other tools needed occasionally.

Cutting rabbets, fitting and fastening parts of stem and stern

Two and Half Million—the Population of a Vacant City Lot

IN a little town in Illinois, Mr. George N. Wolcott conducted an investigation to find out how many animals—or, rather, forms of animal life—inhabited an acre of city land. The count in a city lot, obtained by multiplying the contents of a bucketful by the figures required for an acre, disclosed the fact that there were between two and a half millions of grasshoppers, locusts, crickets, cockroaches, earwigs, lantern-flies, plant-lice, aphids, and other "bugs" in one acre of land.

There will be of course a large variation in the count according to the season in which it is made. For example, there is a one third increase in the population in the spring over that in the autumn owing to the rapid multiplication of earthworms.

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Safety platform for window-cleaners. It is securely clamped inside the window

Step Into the Guard Cage and Be Safe While Cleaning Windows

AMONG the more hazardous callings, that of the window-cleaner has received its share of attention from inventors of safety appliances of all kinds. The windows of a twenty-story office building are not cleaned without risk. Usually the cleaners wear belts which they hook to special fastenings; but not every building has the necessary fastenings.

John H. Cook, factory inspector for the Utah State Industrial Commission, is the inventor of an appliance that can be used on any building. His device consists of a collapsible platform which is clamped to the inside of the window and which supports a high guard-cage on the outside. The platform can be quickly attached and detached, and the whole apparatus weighs only fifty-eight pounds, which makes it easy to be carried up and down our skyscrapers.

Thowing Light on the Dark Secrets of the Mouth

IT will no longer be necessary for a person who desires to count his teeth, or to see whether they need the attention of a dentist, to turn and twist himself before a mirror, with his mouth open till the hinges creak, trying to make the light strike so that he can get a view of his molars and bicuspids and other dental appurtenances. No, he can now put the light inside of his mouth, thanks to a new device which is compact enough to permit this.

This device, which should prove of service to dentists and physicians, is, in effect, an attachment to any electric-light socket, fitted with a voltage reducer so as to light a small opal bulb, to which is attached a small magnifying mirror, and which can be inserted into the mouth and held in place with an attachment to the cheek. Our picture shows it in use, and gives a clear idea of how effectively it illuminates the interior of the mouth and enables the operator to examine with minute care even the back molars or "wisdom-teeth."

This device throws light on dark places and exposes dental decay in time to obtain relief or frustrate its further progress

That hollow tooth in the rear can now be examined with ease, and a plug of cotton saturated with oil of cloves inserted to insure a "sleepful" night.

This invention is not intended to rob the poor dentist of his livelihood. It simply enables the toothache sufferer to obtain temporary relief until it is convenient to undergo a dental operation with its incidental tortures.

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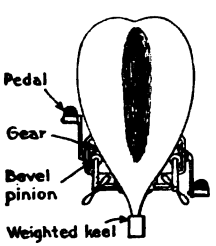
Creosoted Railroad Ties Give Double Service

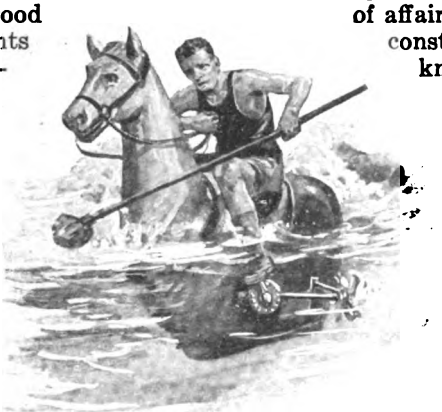
RAILROAD ties last about eight years under normal conditions, when they have to be renewed, which costs a good deal of money and calls for a large force of labor. It is estimated that treated ties which are first kiln-dried and then immersed in hot creosote until saturated last twice as long. They are absolutely water-proof and impervious to rot.

Why Not Water-Polo on Aquatic Polo Ponies?

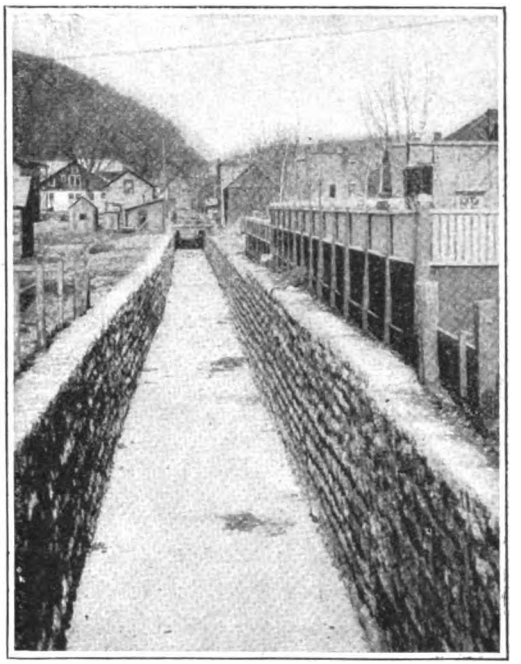
THE mechanically-propelled water horse recently invented by Antonio Alaj opens an interesting perspective in aquatic sports, which, heretofore, have been sadly lacking in variety. Some years ago a game was invented which, for some reason, was given the name of water-polo, although it had little in common with polo excepting the name. But now, thanks to Mr. Alaj's invention, there is no reason why there should not be real water-polo, played by riders mounted on water-polo ponies. For, after all, polo without ponies isn't polo at all.

The water-horse, shown in the accompanying illustration, is equipped with twin propellers which are rotated independently in either direction by a crank and gear arrangement operated by pedal. A good rider should be able to put his water-horse through the same paces through which good polo riders put their mounts and that would make possible fine sport, scarcely less exciting than land-polo and very much more novel as well as romantic.





The liveliness of the horse depends upon the strength of the rider's nether limbs



The hundred-thousand-dollar aqueduct which protects the town of McGregor against damage from periodical floods

Side-Tracking a Flood by Means of a Gully

THE little town of McGregor, situated in a pocket in the hills in Iowa, has had literally to entrench itself against invading floods. Because of its peculiar situation, every time there was a heavy rainstorm in the surrounding hills the unfortunate little town used to be swamped. To cope with this state of affairs the authorities have constructed what is locally known as the "Hundred-thousand-dollar Aqueduct"—a great rock and cement gully a mile long, which runs down the main street. Other branch water-courses are laid through the side streets, so that now any flood-water that comes down is side-tracked along the gullies and the town is safe.

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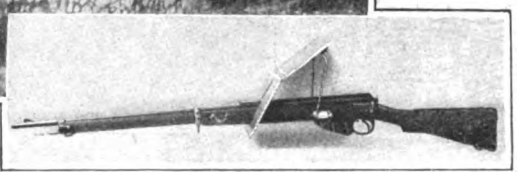
American Army rifle with the bullet-proof shield in position and ready to shield the marksman



This side-view shows how the shield is adjusted on an ordinary American rifle

depend on the distance at which it was expected successfully to withstand rifle fire. Although it is probably too heavy to be carried by the individual soldier on long marches, provision is nevertheless made whereby it can readily be attached to the cartridge belt. The contrivance is believed to give full protection against rifle fire at five hundred and fifty to six hundred feet. If it is not too cumbersome for the soldier, already loaded down, there may be a chance for its adoption by the army.

Bullet-Proof Shield to Protect Riflemen in the Field

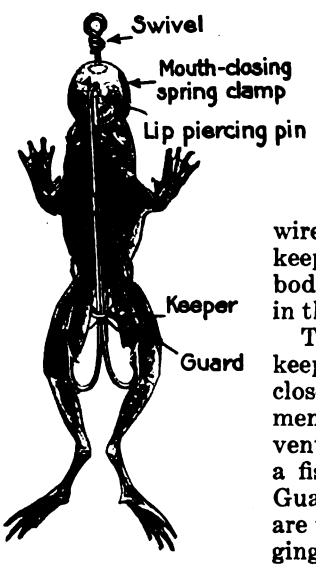
THE bullet-proof shield shown in the accompanying illustrations is the invention of Samuel J. Winn, Jr., of New York city. It is intended to give a fair degree of protection to riflemen firing from the trenches or in open territory, where natural covers are lacking. It may also be adapted for use with machine-guns.

The shield is made of an alloy of chrome and vanadium steel, with drop-forged rivets and other accessories. It consists of an upper and a lower part, which, when applied over the muzzle of the rifle, is shifted rearwards to a point near the lock and held there in an oblique position by the upper edge of the port resting on the lock's casing and supporting the shield. There is also a second port above the first on the lower half of the shield and in line with the sight of the rifle, so that the user will be shielded while aiming the rifle.

The total weight of the shield, with its lower part of a thickness of three and its upper part of four millimetres thickness, is seven and three-quarter pounds. The weight of the shield naturally would

Keeping Live Bait Alive on the Newly Devised Hook

FISHING without bait is a hopeless undertaking. Certain kinds of fish are so fastidious in their tastes that they can be tempted only by live bait. But, fishing with live bait, as practiced heretofore, besides being unnecessarily cruel to the bait, presented many difficulties. One of the greatest difficulties was to keep the bait alive. This difficulty is overcome by a device recently invented. A flexible clamp at the swivel is used to hold the bait by the mouth, while a pin passes through the holes in the clamp and through the lips of the bait, and is then bent downward and held in place by a keeper. A wire loop, also held by the keeper, may pass around the body of the bait as indicated in the illustration on the left.



How live bait is held to keep it alive

The clamp is useful also in keeping the bait's mouth closed during rapid movement through the water, preventing drowning, for even a fish or a frog can drown. Guards for the hook points are useful in preventing clogging by weeds. They also serve to balance the bait and keep it in a natural position.

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It Works Like a Typewriter, and It Marks Linen with Precision

WHO is not familiar with the blurred illegible mess that very frequently results from the efforts of the laundry in marking linen? The fact that the ink is indelible does not add to the pleasure of the owner of the linen either. Now appears the power marking machine, made by a Cincinnati firm, which will do the work much more speedily, quite as permanently, and infinitely more neatly than any pen and ink, or a rubber stamp, ever used.

Instead of the usual smear on our linen, we shall now have it marked by this machine

JONES	W-349	GREEN	Z2485
BROWN	X117	BLACK	M6

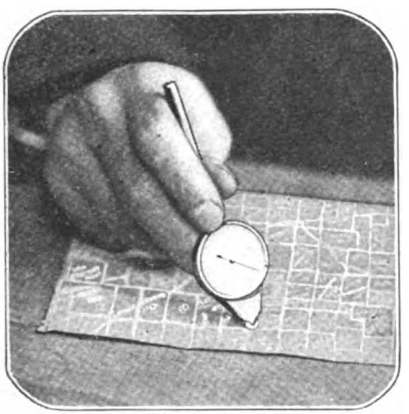
The machine itself is very compact. It is much like an adding machine in appearance, for it has a bank of keys for selecting the letters. The letters are composed by means of the keyboard, and the machine holds them firmly while they are linked by an automatic device. Then the mechanism presses the letters firmly against the article to be marked, which is held in a slot. The machine is operated by a one-tenth horse-power motor, and as it contains several alphabets and all the necessary signs and points, its scope is very wide. There is a guard on the machine to preclude the possibility of injury to the operator. The manufacturers of this machine assert that the saving over the hand method in time and reduced claims, frequently runs as high as forty percent. However that may be, it is certain to make our linen look better.

Run It Along the Map and Then Read Off the Inches on a Dial

FOR rapid work in scaling blueprints and other representations drawn to a scale, a new rotary measuring device has been invented which makes possible a direct reading in inches of the distance between any two points on the print or map regardless of direction, and it is especially useful for irregular lines such as streams.

The tracer wheel is placed at one end of the distance to be measured and is then rolled to the other end of the course; the dial then indicates the distance in inches. The actual distance between the two points represented can then be obtained from the scale of the drawing. An inner scale is graduated in inches to facilitate conversions from the English to the metric system, or vice versa, and also to make it possible to use the device on prints and maps with a metric scale.

The accompanying illustration shows how the tracer wheel is run over the blueprint and how the dial, actuated by the tracer, does the work of indicating the distance traversed, and does it with unerring mechanical precision. For the draughtsman, the chart-maker, the architect and the map-maker this device should prove to be a veritable boon. Much time will be saved and many mathematical calculations rendered needless by its use.



Rotary measuring device with dial that indicates distance between two points on the paper

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Solving the Airplane Spruce Problem

How the I. W. W. is foiled; how wood-waste in building airplanes is now avoided and slow air-drying gives place to quick, efficient kiln-drying

By Frank Parker Stockbridge

THERE are six hundred separate pieces of wood in each military airplane. Ash, hickory, mahogany and other woods are used for the propellers, the body and some of the stiffer members of the wing-frames, but the airplane builder relies mainly upon spruce. Spruce forms the beams and braces that make the wings; spruce because it combines lightness, toughness, elasticity and strength. There are other light woods, such as white pine, but white pine does not readily spring back to its original form after being bent, as does spruce. Hickory is tougher and is elastic, but it is heavy; moreover, there is not enough hickory in the whole world to provide the timbers needed for the huge airplane fleet which is being built for the United States Government. So, of all the other woods that are available — none combines the qualities upon which the airman must depend for safety in flight as does spruce.

No Metal Is as Whip-like as Spruce

Even the lightest and most resilient of metal alloys, of which scores have been tried, crystallizes under the incessant vibration of 2,500 revolutions a minute, the engine speed necessary for flight at 150 miles an hour, which is not uncommon in modern warfare. No metal has the whip-like quality of resiliency which the essential members of the airplane frame must have to withstand the quick turns, the tail-spins, wing-spins, nose-dives, loops and other flying tricks, once exhibition "stunts" to be performed only by the most foolhardy, now every-day commonplaces in the aerial pursuit of the enemy. "Could the swiftest bird see and comprehend the things the modern airman does," says a famous American physicist lately returned from the front, "the bird would marvel even more than the untutored savage marvels at the bird."

It takes one hundred and sixty-seven board feet of clear, straight-grained, seasoned spruce to construct a single military airplane. Although this figure varies somewhat in different makes of types of machine, it is the average for military planes. But if a man walked into a lumber-yard and gave a casual order for one hundred and sixty-seven feet of this sort of lumber, the lumber dealer would laugh at the sheer impossibility of the thing. There has been no substantial amount of clear spruce in the Eastern lumber markets for years; in fact, old builders say they have not seen a single clear spruce board in twenty years. With the beginning of the European war France and Great Britain turned to America not only for airplanes but for the spruce lumber needed to build them in Europe. Spruce jumped to a premium, and up in the Northwest, around Puget Sound and in Alaska, timber-cruisers began hunting for the tallest, biggest, straightest specimens of the Sitka spruce, the tree that yields the finest quality of this lumber.

Speeding Up the Spruce Gatherers

Even before the United States entered the war, great difficulty was experienced in getting enough spruce for the airplane demands of the Allies. This was caused by labor troubles in the Northwest, where the I. W. W. almost completely tied up logging and lumbering operations for months, transportation difficulties, and the heavy wastage in getting out the long, straight pieces required for the longerons of the wing-frames. After the lumber was gotten out, it had to be seasoned. Even by the quickest processes in common use this required from three to six months, and there was great waste through checking and warping whenever efforts were made to speed up the drying process.

The total production of spruce lumber in the United States in 1916 was about

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30,000,000 feet. When the plans of the Aircraft Production Board were finally approved by Congress and the United States entered upon its gigantic program of airplane construction it was estimated that a quantity as great as that would be required before the end of 1918 for our own airplane requirements alone. To speed up the production of spruce lumber, to cut down waste in manufacture and to devise some means of curing the lumber to the point of absolute perfection required in airplane work were the three big problems that the Government had to tackle. All three of them have been solved.

For speedier production there was organized the Spruce Production Division of the Army Signal Corps under the command of Colonel Price P. Disque, U.S.A. Two elements had to be combated—the activity of the I.W.W. and the actual shortage of skilled lumbermen in the regions where the best spruce is found. Colonel Disque decided to fight the I. W. W. with the L. L. L. L.—the Loyal Legion of Loggers and Lumbermen. The idea took hold quickly. It gave the men in the woods and the mills something tangible to tie to. Every one of its members, which now include a very large proportion of woodsmen, mill workers and lumber operators in the Northwest, subscribes to the following pledge:

"In consideration of my being made a member of the L. L. L. L. I do hereby solemnly pledge my efforts during this war to the United States of America and will support and defend this country against enemies, both foreign and domestic. I further agree, by these presents, faithfully to do my duty toward this country by directing my efforts every working day possible to the production of logs and lumber for the construction of army airplanes and ships to be used against our common enemies; that I will stamp out any sedition or acts of hostility against the United States Government which may come within my knowledge, and I will do every act and thing which will aid in carrying this war to a successful conclusion."

The logs are split by wedges driven in by a kind of pile driver device—a beetle

To supplement the working forces already in the forests, the Government went into the lumber country of Minnesota and began organizing "spruce regiments," enlisting loggers and lumber mill men for the Signal Corps, to go into the Northwest and get out the airplane lumber. Transportation difficulties have been largely overcome by the establishment at Vancouver, Wash., on Puget Sound, of a Government Cut-up Shop, where finished parts for airplanes are shipped East, although a great deal of the lumber is still shipped to the factories in the rough.

Cutting Down the Waste

Waste was a serious factor. By former methods of producing the lumber, it took about 1,000 feet of rough lumber to yield the one hundred and sixty-seven feet necessary for an airplane. This waste has been largely reduced, and before long it probably will take only 500 feet of lumber to each machine. One cause of the waste was the custom of sawing the logs into planks paralleling the heart or pith of the tree. The grain of wood runs parallel with the bark and not with the pith, so that when the strips for the longerons and other parts were split out of the planks there were always long

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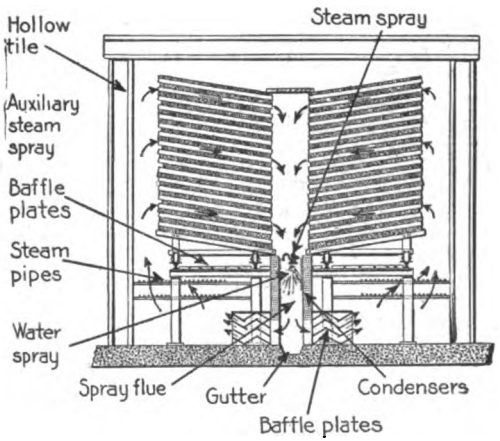
wedge-shaped pieces left, and many planks would not yield a single long, straight, clear piece with the grain running exactly parallel to the sides. To meet this difficulty, the system of getting out timbers by splitting or "riving" the logs into the beams or "cants" has been adopted. If the tree is straight-grained to begin with, rived cants are sure to be straight-grained, too. No explosives are permitted for splitting wood for airplane purposes, but all must be rived in the old-fashioned way, with wedges driven in by beetles.

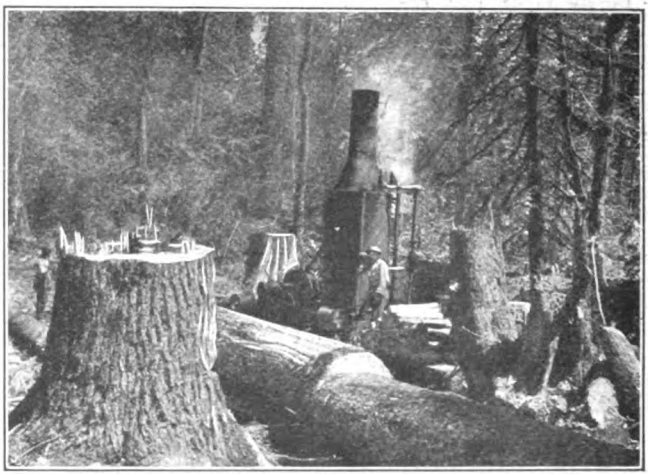
Signal Corps specifications for this lumber call for cants from 18 to 26 feet long, not more than 14 inches thick or more than 3 feet wide on the bark surface, with growth-rings not closer together than six to the inch. No piece may be less than seven inches in its smallest dimension or less than 50 square inches on its smaller end. Only the sap-wood is used, the hearts being entirely discarded. For this class of lumber the Government is paying bonuses for speedy production as high as $40 a thousand feet above the base price of $90 per thousand.

How to cure the green lumber, fresh from the forest, and make it equal to the best air-seasoned lumber that had formerly been the standard, but in a trifling fraction of the time required was the most vital problem of all. Thorough air-seasoning of such stock requires from one to three years. For a long time the Forest Products Laboratory of the United States Forest Service at Madison, Wis., had been making a scientific study of the drying of wood, and had developed some very successful methods. A large shipment of perfectly green Sitka spruce was sent to Madison, together with other woods used in airplane work. H. D. Tiemann, the Forest Service expert on the subject, was set to work on the problem, and by the adaptation of principles previously applied in the laboratory's experimental work, a system was evolved that is being used successfully to season the green spruce in fourteen days, or even a shorter time. Careful tests made by the Forest Service prove that this kiln-dried stock suffers less injury to its essential mechanical properties than does air-dried lumber, and the Forest Service specifications worked out from these experiments have been applied in dry-kilns con-



Here Green Lumber Is Seasoned

This diagram shows the arrangement of the dry-kiln devised by the Forest Service for seasoning green lumber in about two weeks. The kiln is so arranged that the amount of moisture in the air can be perefctly controlled. At first the air is kept moist to the point of saturation by injecting a fine spray of water into the flue through which the air passes. The heating of the drying chamber is effected by a system of steam pipes. For use at very high temperatures an auxiliary steam spray is provided. The condensed moisture runs into a gutter and is conducted back to the pump. The heated air rises above the heating pipes, circulates between the piles of lumber and, when it is cooled off, sinks down to pass again over the hot pipes, repeating its course



This is a typical scene in one of the Northwestern lumber camps whence practically all the spruce for making airplanes is obtained. The men have pledged themselves to stick

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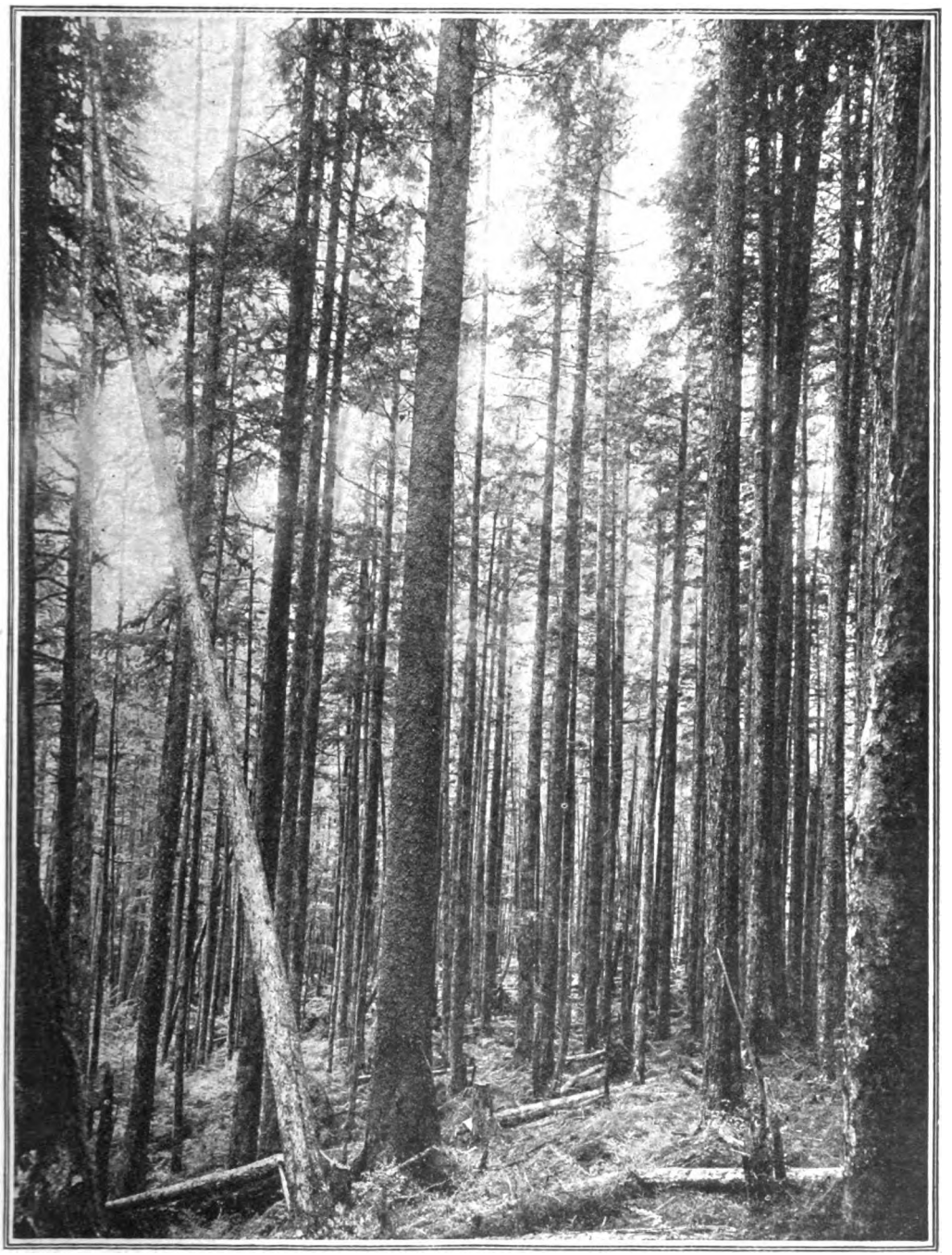
Soon They Will Be Airplanes



There was a time, not so many years ago, when spruce trees were common in this country. They are no longer plentiful. Reckless and wasteful deforesting has nearly eradicated this noble and useful timber. When the requirements of airplane building caused an urgent demand for spruce lumber, it became necessary to draw upon the resources of the Northwest. Around Puget Sound and in Alaska fine spruce forests may still be found and these supply practically all the spruce lumber which is used in building airplanes in this country under the direction of the Aircraft Production Board

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structed under Government supervision, with the result that airplane lumber is now coming through in unheard of quantities and of a quality heretofore not generally obtainable.

A Saving Plan of Drying Airplane Spruce

The new kiln-drying method is based upon the fact that moist air with ample circulation is a more effective drying agent at moderate temperatures than is superheated steam or dry air at high temperatures. Since airplane lumber must be absolutely perfect, not only free from knots even as large as a lead pencil, but entirely without checks or cracks, the faults of ordinary kiln-dried lumber must be avoided. Too rapid evaporation dries the surface of the wood, causing case-hardening, as a result of which the more slowly-drying center of the plank shrinks away from the outside, causing "checks" or internal splitting. This also happens with air-drying at times. In the Tiemann kiln the lumber is heated clear through before drying begins and the humidity of the air is regulated so that the flow of the internal moisture to the surface of the wood is at the same rate as the surface evaporation, or even faster. At the beginning of the Tiemann process, in fact, the heated air of the kiln is humid to the point of saturation. After the lumber has been heated through, the humidity is gradually reduced, so that drying is from the center outwards. As will be seen from the accompanying diagram of the new kiln, temperature, humidity and circulation are always under control.

Some of the spruce logs, like those shown in this picture, attain a diameter of four or five feet, but most of them are thinner

Exit the Saw—Enter the Edge-Tool

When the rived spruce cants, kiln-dried by the new process, reach the finishing shops, every piece that is to be subjected to bending or twisting strains in the finished airplane is split from the plank or cant, instead of being sawed, and is smoothed and finished to shape so far as possible by sandpapering alone without the use of edge-tools.

So completely has the production of spruce and its conversion into airplanes been organized that it is now possible for an airplane to be on its way to France built of lumber that less than a month before was standing trees in the forest. What appeared at first to be insuperable difficulties have been overcome by the Government experts assigned to this special service.

Hypodermic Needles of Gold Instead of Platinum

THE war has upset many old standards and set up new ones. One of the curious results of this upheaval is that gold has been reduced, in some cases, to the rôle of a cheap substitute for other metals. Hypodermic needles, for instance, were formerly made of platinum or platinum-iridium, two metals now practically unobtainable. The increased war demand for these needles led to many experiments with other metals and alloys in the hope of finding a good substitute. A manufacturing concern, making a specialty of tempering precious metals, has recently perfected a hypodermic needle of specially tempered 14-carat gold, which offers many advantages. The metal has almost the hardness and rigidity of steel, is not attacked by steam, boiling water or chemical solutions used for sterilizing, and the needles are much cheaper than those of platinum or platinum-iridium.

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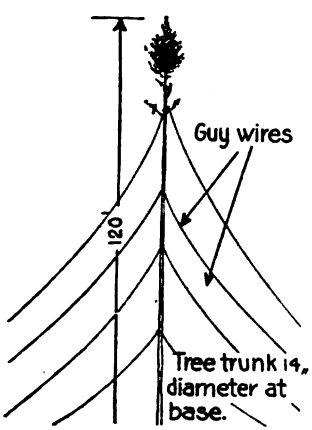
Here's a Dizzy Pruning Job

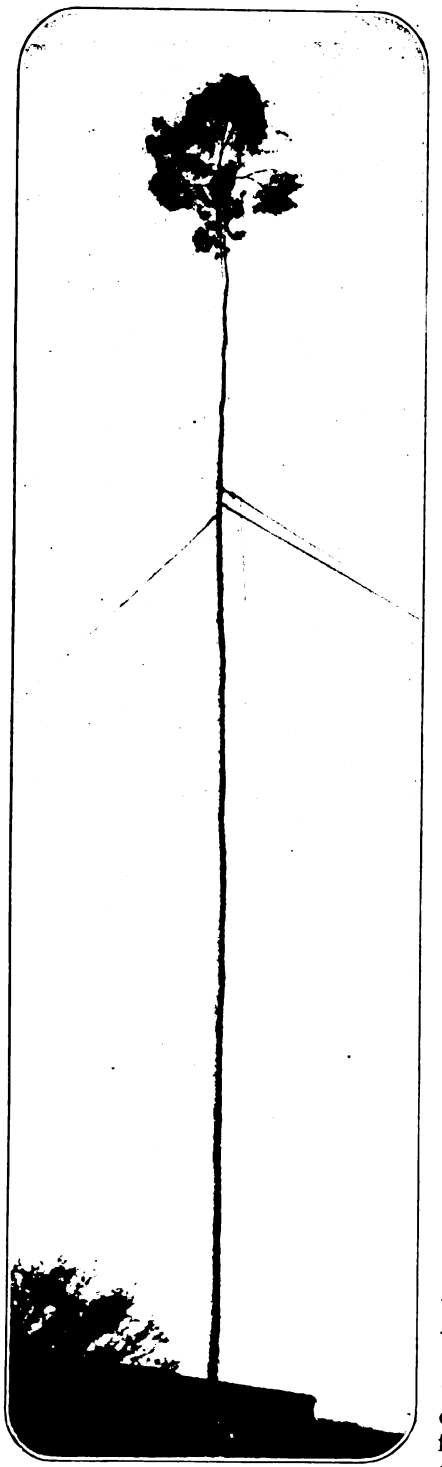
CLIMBING to the top of a eucalyptus tree one hundred and twenty feet high, and only fourteen inches in diameter at the base, in order to do a job of trimming, is the apparently impossible feat recently accomplished by Walter Seidell, a Los Angeles steeple jack.

The odd tree belongs to a firm of nurserymen, and has been cultivated as an advertisement. Recently the tree developed some scraggly looking branches along the length of the slender trunk. Could they be trimmed off? The steeple jack was consulted. He took the job without hesitation.

"It's easy," said Seidell.

Accordingly he strapped on a pair of linemen's pole climbers and wriggled up the first twenty feet of the trunk. Then he tied four wires to the trunk and dropped them to the ground. The wires were spread out at the base of the tree and were tied to stakes driven securely in the ground. Then the steeple jack climbed another twenty feet and dropped down another set of wires. In this way he ascended to the top. By that time five sets of wires were supporting the tree to keep it from breaking under his weight. The sprouts were trimmed off, and Seidell then climbed down, removing the wires as he came.





Trimming a twig 120 feet high and only 14 inches in diameter at the base. Note the man in the tree-top whose dizzy climb has called forth skill and courage

Great Sums to be Spent for Roads

THE present railroad situation in the United States has given a great impetus to the building of good roads throughout the country. The staggering total of $263,069,610 is the amount that will be expended on highways during the current year by the National Government and the different States. Texas heads the list with an appropriation of $25,000,000; Illinois and Indiana vie for second place with $17,000,000 each, while New York holds only tenth place with a ten-million-dollar appropriation.

Extensive use of automotive vehicles accounts for the demand for good roads and the enormous sums devoted to them during the current year.

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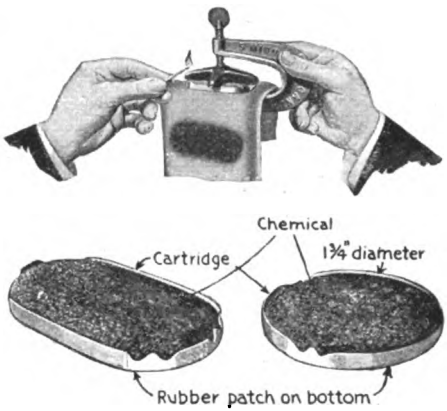
Repairing Automobile Tire Tubes with Matches

TO repair a cut, tear or puncture in the inner tube of an automobile tire, use a match—but the right kind. And what's that? A new type of vulcanizer made in Wisconsin. No steam, electricity or fuel of any kind is needed to generate sufficient heat to cement together the damaged tire tube and the rubber patch, and there is no opportunity for burning fuel to drip off on your fingers and raise blisters.



A convenient contrivance for patching automobile tire tubes at little cost

The heat-generating medium is a neat metal cartridge containing an accurately - measured charge of non-flaming chemical with a patch of rubber attached to the outside of the cartridge. The cartridges are made in round sizes about two inches in diameter for punctures and in oblong units for cuts and tears. The rubber patches are applied to the damaged part of the tube by means of a small clamp, and the cartridge lighted with a match. This ignites the chemical which securely cements the patch in place, after which the cartridge is removed and the job is finished.

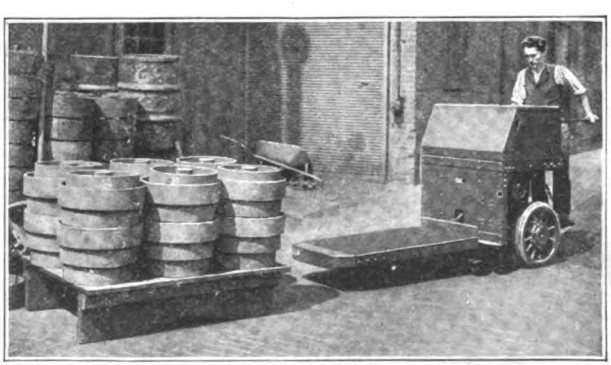
Autoists who have had sad experience with punctured tires will not be slow to try this new remedy, which should not be very expensive. Certainly it is not very difficult of application.

Work a Lever—That's All the Stevedore Has to Do

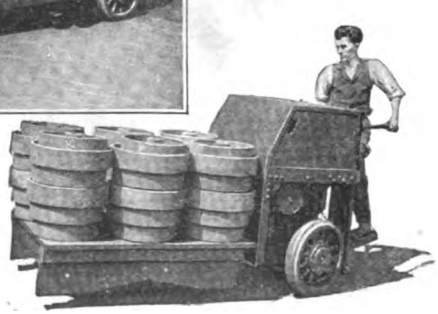
MUCH ingenuity has been expended on vehicles used in loading and unloading freight on wharves or at railroad stations. First came the two-wheeled hand truck, followed by the hand-elevating truck, which was a big improvement.

Then came the efficient electric industrial truck, capable of carrying up to two tons and of moving at three or four times the speed of a man. And now appears the elevating or self-loading electrical industrial truck, the most efficient inside mover of freight because, with it, manual labor is reduced to a minimum.

This remarkable labor- and time-saving device differs from other industrial trucks only in the platform which is mounted on pivoted levers, one at each corner, and in the platform raising means. The elevating mechanism consists of a small electric motor which drives a multi-thread screw through a worm gearing to tilt the pivoted levers to a vertical position. Thus the platform is raised. It is dropped to its low position by its own weight.



Running the truck's lowered platform, mounted on pivoted levers, under the load



The platform, raised by an elevating mechanism, lifts the load and its support

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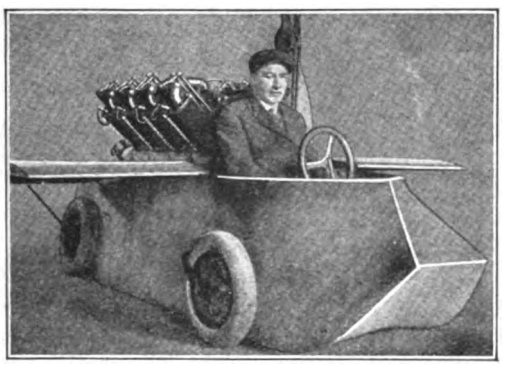
Combining the Eagle With the Goose

A machine which is intended to fly like an airplane, to skim the water like a motor boat, and to run on land like an automobile

By Carl Dienstbach

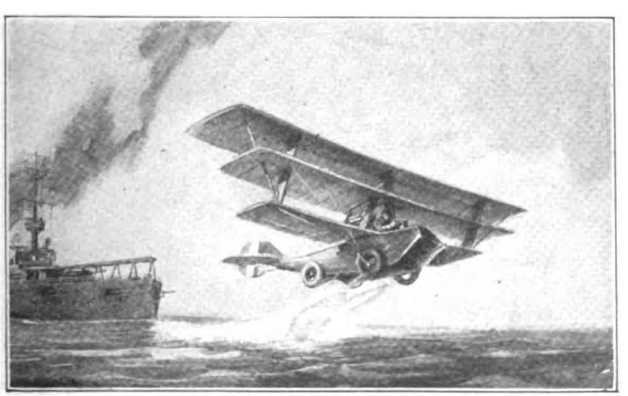
AN airplane must be in motion before it can fly. It must make a preliminary run on the ground or water before it can vault into the air. Here we have a serious limitation in the use of the machine. Not every city has a large park from which the machine can start, nor a nearby waterfront.



The machine invented by Alexander Tesch, combining the motor boat, airplane and automobile

In order to give the flying machine the attributes of a boat and an automobile, so that it can be driven under its own power either to a waterfront or to a suitable starting ground on dry land, inventors have devised some startling combinations. Some of these have already been preserved for posterity in the pages of the POPULAR SCIENCE MONTHLY. The latest to which our attention is drawn is the conception of Alexander O. Tesch.

The provision of a suitable boat body is easy enough. But who shall be the first to provide wings that can be folded back out of the way so that the machine can travel along an ordinary roadway without occupying more space than an automobile? We are not informed of Mr. Tesch's solution of this phase of the problem.



If developed along the lines suggested in this article, the machine, in flight, would probably look like this

Nor has Mr. Tesch told us anything about the very necessary tail of his machine and how it is to be disposed; nor of his propeller, which must be prevented from guillotining pedestrians.

The engine is said to be of one hundred and eighty horsepower, which seems to be sufficient to drive the machine up hills.

The machine as it is pictured in the photograph, is a monoplane. But a triplane must be the inventor's ultimate plan. A three-decked machine would not be nearly so high as an ordinary motor truck and might even be permitted to run along the street. Moreover, triplane wings could be made to fold back around vertical pivots in the center. A triplane would be sturdy enough to endure the shaking which would result from running over poorly paved streets without danger of loosening stay wires or wing coverings.

It must be admitted that machines and engines have become so sturdy that the whole scheme of using an airplane as an automobile is far more feasible than it was five years ago and new improvements and startling developments may be looked for any day.

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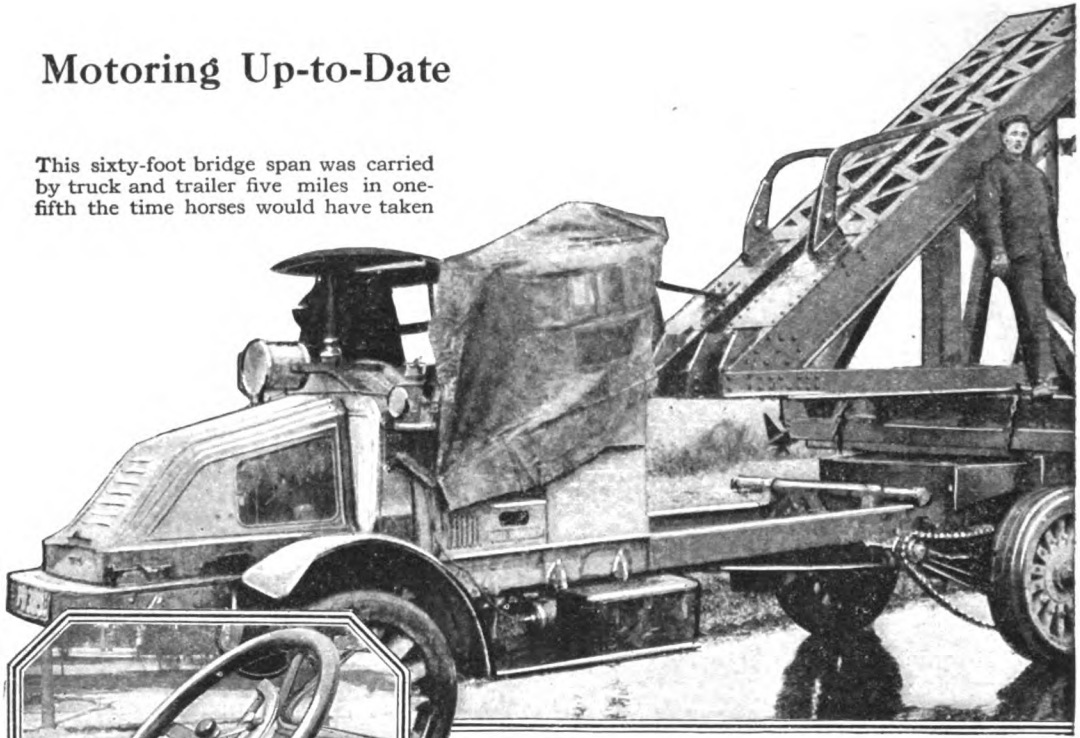
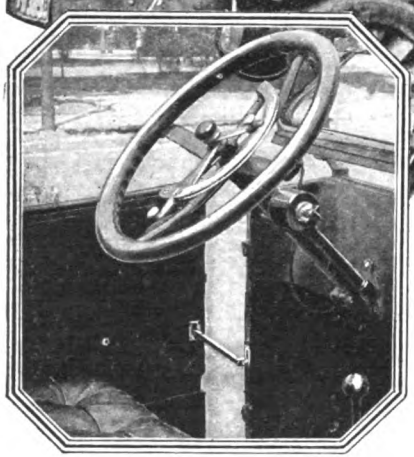
Motoring Up-to-Date

This sixty-foot bridge span was carried by truck and trailer five miles in one-fifth the time horses would have taken

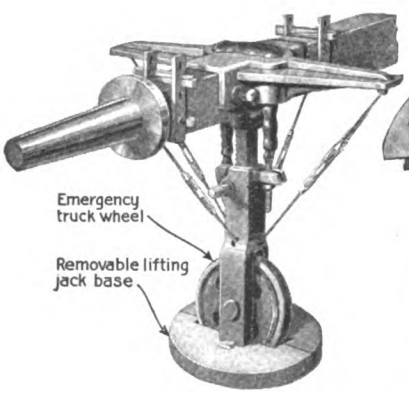




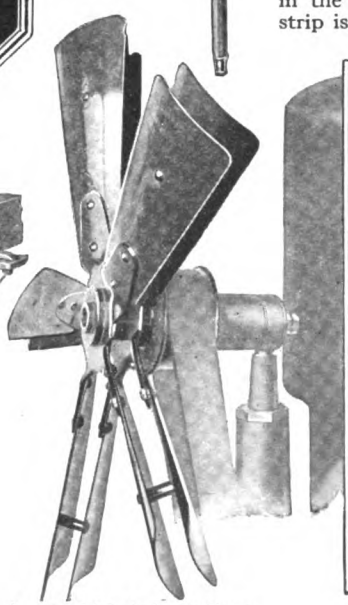
A hook to hold the front door of a car open in summer

A combination tool consisting of a tire gage, compression gage and magnet tester is shown at the left

To make lighting of the oil lamp at the right easy in the wind a sandpaper strip is fixed on the inside



Combined jack and wheel for raising an axle and towing in a disabled car



A dual-bladed radiator fan for automobiles that gives increased air

A combination lock for closed car doors. This lock saves hunting for the key

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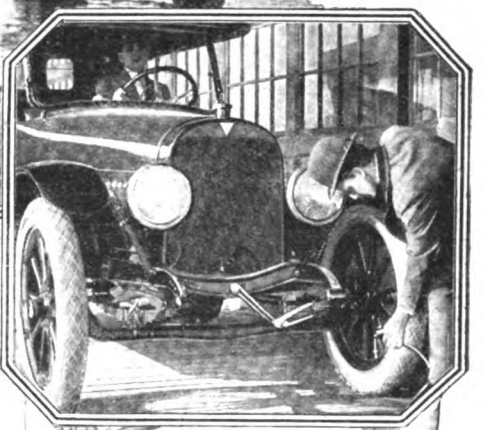
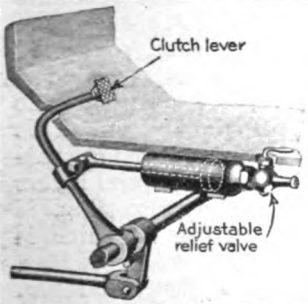
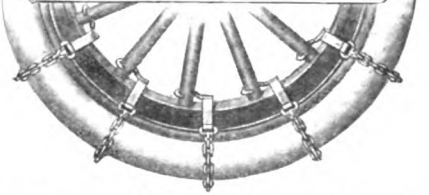


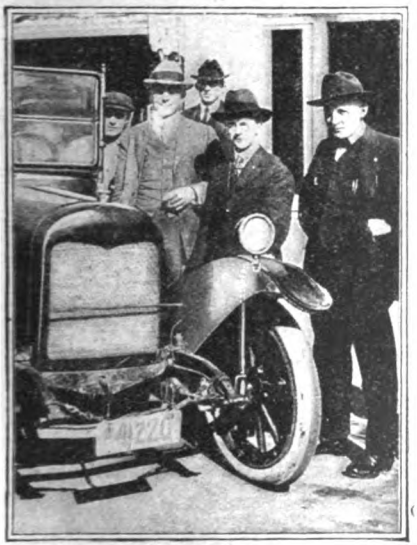


The crank-holder at the right is a piece of inner tube lashed to the spring

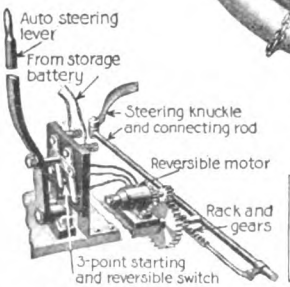
At the left is a compression pump attached to a clutch lever to make its engagement smooth



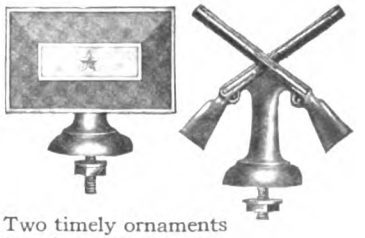
Individual anti-skid tire chains. One chain to a spoke



A lamp made dirigible by being connected with steering knuckle pin



A motor driven steering device operated by a lever on which a reversing switch is attached



Two timely ornaments for the radiator cap

A groove cut in a piston ring to prevent oil getting into the cylinder

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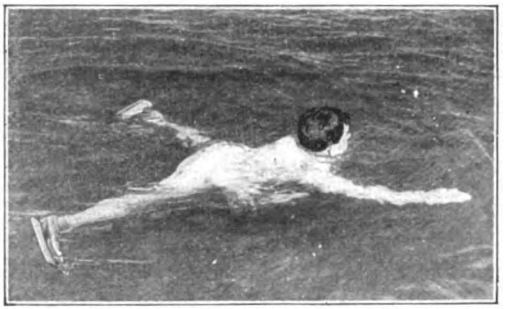
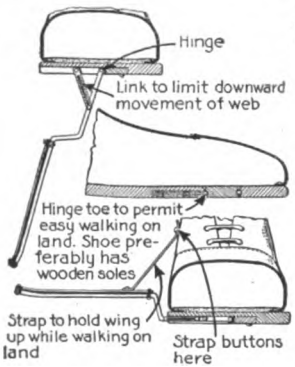
Put On These Webbed Sandals and Swim Like a Duck

WHEN you have tried to swim fast, haven't you wished you had webbed feet like a duck? Conrad Schneider of New York must have wished so, too; for he has invented a "swimming sandal"—an attachable web for one side of your foot. To use his invention you must wear a pair of special wooden soled shoes.



This device is intended to aid the swimmer. A swimmer wearing webbed sandals finds swimming easy—as the common duck does



Hinged to the bottom of each sole by means of metal plates are two steel levers, one at the heel and the other in the center of the sole. Each pair of levers supports at its outer ends a frame as large as a shingle to which is fastened the web, which may be good cloth or other similar material.

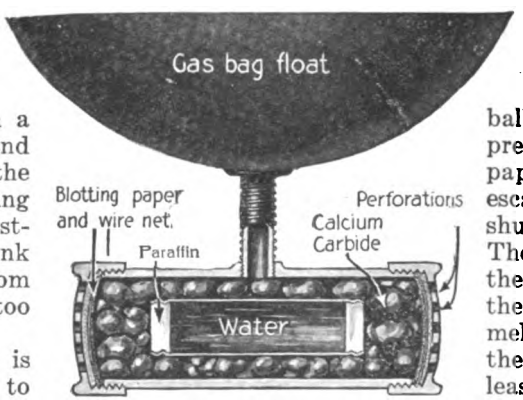
Thrust your foot downward or backward, and the web projects to one side and acts as an extension thereto, thus increasing its effective area in pushing against the water. Draw the foot upward and the web collapses in a downward direction and trails along after the sole of the shoe, offering practically no resistance. A small link prevents the web from moving downward too far.

This contrivance is no doubt interesting to experiment with, but is hardly practicable.

Throw the Life-Preserver Overboard and It Inflates Itself Automatically

"MAN overboard," shouts the lookout. Instantly there is great excitement among the crew and passengers on deck, who scurry around for something to keep the drowning man afloat. When nothing can be found suitable for the emergency and the rapidly tiring youth is about to sink for the last time, a passenger suddenly throws him something that looks like a knitting bag. It sinks on reaching the water, but soon rises, transformed into a balloon, the handle of which the drowning man grasps and keeps himself afloat until a boat comes to rescue him.

This device consists of a rubber balloon encased in stout canvas and connected by a strong tube with a metal cylinder, which serves as a handle and holds the chemicals for inflating the balloon. This cylinder, closed at each end by a perforated metal cover, backed by several layers of blotting paper and wire netting, is filled with calcium carbide in which is embedded a small tube holding water, closed at both ends by stoppers of paraffin. When the device is submerged, water penetrates through the perforations and soaks through the blotting papers, communicating moisture to the carbide. Acetylene gas is at once generated, which inflates the balloon, and by compressing the blotting paper, prevents the escape of the gas and shuts out the water. The heat generated by the decomposition of the carbide, however, melts the stoppers of the tube and the released water keeps up the supply of acetylene gas for the balloon.



This life-saver with ingenious mechanism is good for emergencies

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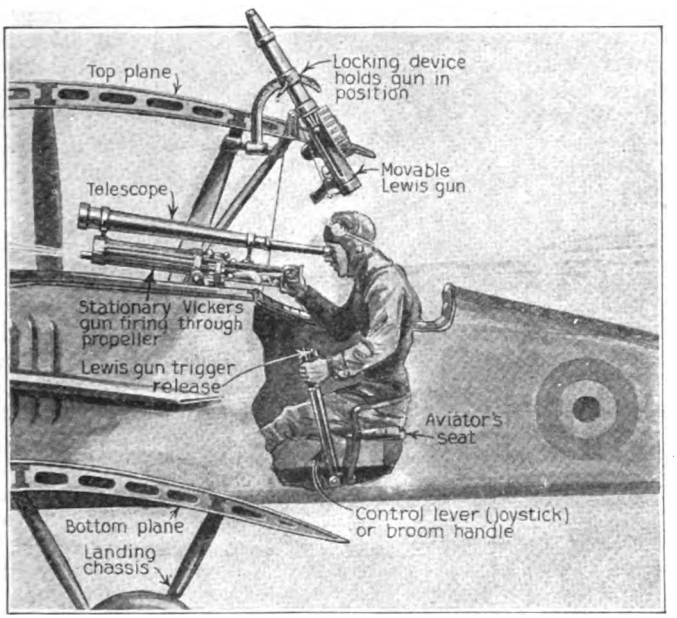
Firing Two Guns at Once

An ingenious method of firing both overhead and straight ahead in British fighting airplanes

As readers of the POPULAR SCIENCE MONTHLY know, the machine-gun of a fighting airplane is fixed in position. It fires through the propeller, the gun and the propeller being so synchronized that the bullets will not hit the blades. In some Nieuport airplanes as many as five machine-guns can be fired simultaneously, three of the guns being mounted on the top plane, and two in the usual position to fire through the propeller. All of these five guns are Vickers-Maxims and fire straight ahead. The entire machine must be turned to aim them.



It is a busy time for the aviator when he has to fire at one enemy in front and another above him at the same time

It is conceivable that a situation might arise when the pilot of the fighting plane must be prepared to meet not only an adversary who is swooping down on him from overhead but also another adversary in front of him. In such a situation his fixed machine-guns will aid him little, especially against the man above him. In one of the latest British one-man fighting machines, therefore, two machine-guns are so arranged that the pilot fires both of them at once and yet one of them enables him to fire overhead. One of the machine-guns is a Vickers-Maxim which is fixed and which fires through the propeller in the usual way; the other is a Lewis which is attached to the upper plane and which is fired from the control lever or "joy stick," as it is called. The Lewis gun has a locking device operated from the butt by pushing a button, so that the gun can be locked in any position on its swivel.

Suppose the pilot is attacked by two enemy planes. He has only to lock the Lewis so that it fires straight overhead and to turn his plane toward one of the oncoming foes. With his right hand on the Vickers' trigger, he can open fire as soon as the range is ripe. His left hand is on the control lever with which he governs his airplane and also fires his Lewis. The Vickers starts its sharp crackle as he gets a bead on his enemy. Above him appears another enemy machine. A quick glance upwards, then a sharp pressure with the thumb of the left hand on the gun trigger release attached to the control lever. Rat-tat-tat-tat! and the man who has been hovering over him like a hawk receives a stream of bullets.

Throughout the entire fight, the pilot is able to keep his left hand on the airplane control lever. When he changes drums on the Lewis, he uses his right hand. These cartridge drums are so made that they can be renewed without any difficulty in a few seconds.

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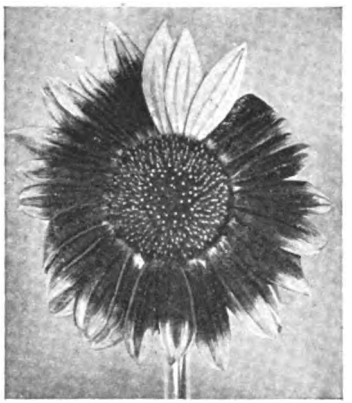
Why Should a Red Sunflower Have Some Yellow Rays?

THE sunflowers of which we publish photographs are remarkable because in one of them three rays (a sunflower's "petals" are called rays) are yellow and the rest a deep chestnut red, and because in the other, the rays are about half yellow and half red. Normally these sunflowers are solid chestnut red. Some change must have taken place in the cells of the flower, with the result that the colors were intermixed. What is the explanation?

Science tells us that after fertilization takes place the characters of the resulting individual are fully determined. The egg determines what shall be the nature of the chicken ultimately hatched. Of course, these characters may be constantly modified by environment. However, we are beginning to doubt this, for there are many exceptions, especially in birds, insects and mice. As a general rule, changes are supposed to occur only in germ-cells and not in body cells. But the sunflower offers an exception. Do the yellow rays represent a germ or body change? To this question the scientists can not give a definite answer, although they say that the change can be more easily explained by supposing that the body cell was influenced in some way. If the change took place in the germ cell, each yellow ray must have been derived from two different types of cells, the yellow predominating over the red. On the other hand, if the change took place in the body cell, one of the known color determiners of the flower, in this case the red, became lost, and there was nothing for the rays to do but grow on yellow cells alone.

How Did It Happen?

The sunflowers in the accompanying illustrations present an interesting problem. Plant biologists have advanced various theories to explain the freakish coloring, but the question is by no means definitely settled. The original photographs were kindly supplied by the American Genetic Association



We Know Some Human Beings Like These Caterpillars

THE Pine Processionary caterpillar has a strange habit of taking long hikes in search of food. These expeditions are always conducted in a long procession, the caterpillars marching single file, the head of each caterpillar just touching the tail of the one in front. The leader alone has the right to wander where he pleases. The others, guided by an age-long instinct, follow unquestioningly.

The thought occurred to J. H. Fabre, What would happen if the caterpillars could be induced to walk in a circle so that there would be no leader? He satisfied his curiosity by studying a procession of caterpillars which were marching around the rim of a large vase in his greenhouse. He carefully removed the caterpillars which were not necessary to form the complete ring and proceeded to watch the result.

For seven whole days, except at nights, the caterpillars continued the march along that fifty-three-inch circle. They became emaciated and so fatigued that they could scarcely move. Yet the only rest which they had during the whole period was at night.

Now the most tempting food, in the form of strong-scented pine needles, was close at hand. By deviating only a very few inches from the beaten path, the hungry caterpillars could have obtained nourishment, but, like the blind adherents of a religious faith, they kept up the march unto the end.

Not a single one of the caterpillars had the initiative, the intelligence, to emancipate itself from the compelling power of the instinct which had come to it from countless generations of ancestors.

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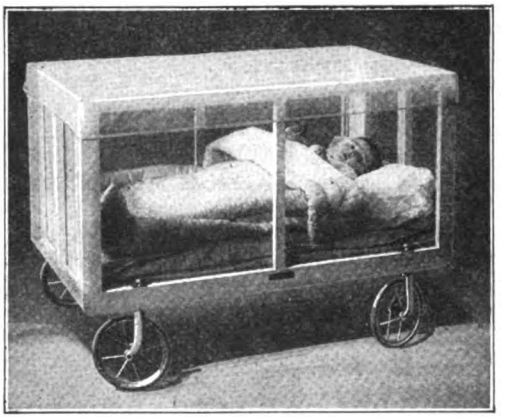
Plant Vegetable Seeds in Used Paper Cups

WHEN a paper cup has been used, it is generally regarded as fit only for the waste-basket. But out in Nashville, Tennessee, there is a drug-store proprietor who conceived the idea of making such cups useful for the planting of seedling vegetables of various kinds. He saves all those that have been used at his soda counter and turns them over to truck gardeners who are glad to make use of them. The plants are started indoors in these paper cups and afterwards transplanted outdoors without disturbing the roots.

Such paper cups are just as serviceable as earthen pots and have the additional merit of costing next to nothing.



The tot sleeps in comfort and safety, unannoyed by drafts or insects

The baby can stand in its crib, happy and contented, because at liberty to exercise its limbs

What to Do with Old Tea-Kettles. Make Them Into Flower Pots

WATER boils at 212 degrees Fahrenheit at sea level. On top of a mountain it boils at a lower temperature, because of the lesser pressure of the atmosphere. You can make water boil at ordinary room temperature with the aid of a vacuum pump.

All this explains why the boiling of water in the San Bernadino Mountains in California was a problem. Tea-kettles fill up with limestone very readily. Usually there are two or three kettles to be found in the junk pile of every homestead.

H. L. Thompson, of Waterman Canyon, has found a way of making them into hanging flower pots.

A tea-kettle doing artistic duty after its days of kitchen service

Combining the Baby-Crib with the Play Pen for Safety and Comfort

HERE is a novel crib and play pen combined, in which the mother may safely leave her baby while attending to household duties—thus relieving herself of much worry.

When asleep, the screened top and sides guard baby effectively against drafts and insects; when awake, the top is removed so as to give the baby free play to use its limbs. The sides admit light and air, and are so high that they prevent the child from toppling out when looking for a toy. The rubber-tired wheels work on swivels when the bed is to be moved about, and can be made stationary when desired.

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Spectacles to Help You See Under Water

Why you can't see under water as well as in air and how properly designed spectacles will help you

By Lindley Pyle,
Associate Professor of Physics, Washington University

PLUNGE the face with open eyes under clear water. Distinct vision is an impossibility; distant and near objects are alike blurred. The immersed eye is afflicted with a formidable case of far-sightedness, and it is powerless to accommodate itself to the extraordinary conditions of contact with a liquid medium. A brief consideration of a few well-known facts of physics and of anatomy points the way to the nature of the handicap and its remedy.

Spectacles That Make the Swimmer See

The spectacles worn by this swimmer make the rays of light converge to a point one and one-half inches behind the cornea. If it were feasible to place the lenses in direct contact with the cornea, this focal length could be reduced by one-fourth of an inch. The lenses make vision under water normal. A diver encased in his special suit would not require the use of such glasses, since his eyes are not in direct contact with the water

The human eye is essentially a sac of watery liquid, the front wall of which (the cornea) is a thin, tough, transparent, spherical membrane. It is unnecessary to detail the functioning of the iris and the crystalline lens which are found in the eye fluids behind. Suffice it to say that when the normal eye in contact with air is focused upon a distant luminous point the light rays sent to the eye are refracted (changed in direction) so as to converge toward a point one and one-quarter inches behind the cornea. The converging refracted rays do not continue their direction toward this point; they suffer a further refraction in traversing the crystalline lens and ultimately converge to a point on the retina, or rear wall of the eye-sac.

If the medium in front of the cornea be water instead of air then refraction in the eye system occurs at the crystalline lens only. Light rays will now traverse the cornea with no change in direction, for the bending of a ray traversing the boundary between two transparent substances arises from a difference in the velocities of propagation of light in the two substances. Since, in the case of the immersed eye, there is no sensible difference between the velocities of light propagation in the water before the cornea and the fluid behind it, light rays will not be deviated in traversing the cornea. Even when operating with its maximum refractive power the crystalline lens alone is too weak to do other than merely converge a bundle of rays to a point far behind the retina. In short, the normal eye in contact with water becomes markedly far-sighted.

With the case properly diagnosed the prescription is easily written. Rays from a distant point must be made to traverse the immersed cornea as if to converge to a point one and one-quarter inches behind the cornea. A convergent lens of glass whose so-called focal length is one and one-quarter inches *in water* will restore normal vision provided the

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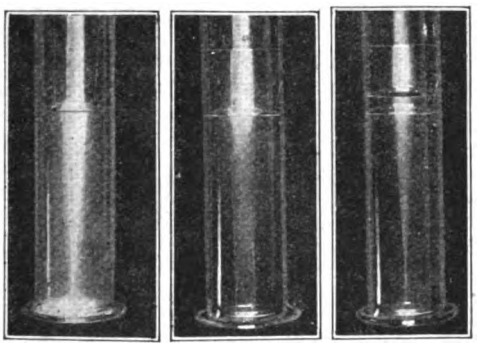
lens be placed in contact with the cornea (a rather painful procedure). If the corrective lens be placed one-fourth inch in front of the cornea, its focal length *in water* must obviously be one and one-half inches; if three-fourths of an inch in front, then two inches, etc. It is desirable to hold the corrective lens as close to the cornea as possible in order not to narrow unduly the angle of view; for lenses of the focal powers mentioned are necessarily small in size.

Assume as the ideal adjustment a corrective lens held one-fourth of an inch in front of the cornea, the focal length of the lens *in water* being one and one-half inches. If the lens be constructed of ordinary optical glass its refractive power *in air* is four times as great as in water, and its focal length *in air* is but three-eighths of an inch. Such a lens would certainly measure across the face not more than one-third of an inch. The unusual appearance of the submarine spectacles of the accompanying illustration is not therefore due to a caprice of the illustrator. The smallness of the lenses has one redeeming feature in that the diver, before entering the water, may see all objects clearly by peering over (or under) his lenses, whereas, under water, vision is possible only when gazing straight ahead.

With normal eyes equipped in the manner described, a swimmer under water may focus his eyes at will upon any object, be it near or far, just as he does in everyday life.

Submarine spectacles should constitute part of the equipment of every aquatic-sport enthusiast. They should find a wide and useful application in all kinds of under-water work such as the clearing of fouled propellers, the collection of corals and sponges, and pearl-fishing.



Why You Can't See Well Under Water

At the left are shown parallel beams of light-rays brought to a focus by a watch crystal (representing the cornea) suspended in a tall jar filled with water. The crystal must rest on the water with no air beneath it. In the center is shown how the addition of water above the crystal destroys refraction; and at the right is shown how a strong lens placed in the water above the watch crystal will make a beam of light converge to the same point as in the picture at the left

The Lesson in Productivity Taught by "Poverty Bottom"

PROFESSOR W. SOMERVILLE, an English scientist, has been conducting some highly successful experiments in the reclamation of farms of low productivity. A large percentage of English farms are located on a chalky foundation, with but a thin layer of fertile soil. Selecting one of the poorest of these farms, aptly named "Poverty Bottom," the scientist found that, by clearing off the gorse, applying basic slag, and sowing clover on the soil he could effect a material improvement. Cattle on the pastures helped to raise its productivity three hundred per cent in six years.

French Fort, Like Anthracite Mine, Has Artificial Ventilation

A FRENCH fort at Verdun has artificial ventilation. It is described by Major-General Charles A. Clement, U. S. A., who visited the firing line. A fort, looked on as the best that French engineering skill could build, was made of reinforced concrete, extending many feet under ground, and stood near the site of the stronghold referred to. It was smashed to atoms by the Germans, but the French, even as the pieces were flying about them, constructed a new subterranean fort of rock and granite which effectually resisted the attacks of the enemy. This fort General Clement describes as somewhat resembling an anthracite coal mine. He said that the air in the fort's hospital was pure and, despite the fact that no sunlight ever penetrated the place, the conditions compared favorably with those of similar institutions on the surface of the earth.

The foregoing description gives us a glimpse of French efficiency displayed in their defense of Verdun.

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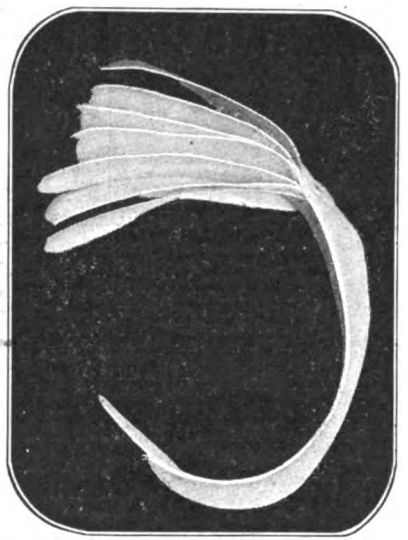
Revolutionizing the Collar Industry

An indestructible collar appears. It is soft but stands up as if starched

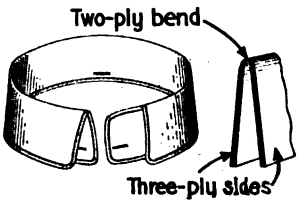
STARCHED collars are complicated in the making, uncomfortable, short-lived, and expensive because of the laundry charges entailed. Hence the increasing use of the soft collar. Now the starched collar is neat—the soft collar is not. Wanted: A collar which is soft but starchless, which looks like the conventional starched collar, which can be cheaply laundered without skill, and which can be manufactured simply and inexpensively.

Have you ever stopped to think of the starched collar's crudities? A rigid band around the neck, with an outer surface greater in length than the inner to enable the cravat to slide freely (which it seldom does); its stiff edges soon fray neckties and wear holes in the shirt front; it must be laundered frequently at ever-increasing expense, and it shrinks in the process; early in life it begins to crack and chafe the neck, necessitating speedy removal.

The starched collar of convention has changed in no essentials, has been static in method of manufacture, in material and in discomfort, since the wife of a Troy blacksmith first made separate collars way back in the year 1825, the idea being exploited by a Methodist minister. Various plies of material are cut into small pieces, the edges are turned by machinery and stitched together, and then the whole is glued together with starch—a matter of ninety different operations, it is said, the greatest number of which require skill.



The multi-ply fabric from which this collar is made is woven in one piece



This soft collar has the virtues of starch without its faults

Now comes J. M. Van Heusen with a seamless collar which can be manufactured in five major operations, which is made of multi-ply fabric, specially woven in one operation and tied minutely together on the loom. In other words, there are not several separate fabrics stitched and stuck together. The accompanying drawings show the manner in which the new Van Heusen collar is woven.

The collar is of the folded or turned-down type, and because of the way the fabric is woven it is adapted to receive a curvilinear set and at the same time be smooth and without folds or wrinkles on either its outer or its neck-band surface. The fabric has sufficient "body" to permit it to retain its upright and circular contour, without the use of starch or other stiffening agent. It is flexible enough to accommodate itself to the movements of the neck, so that it has none of the stiffness of the standard laundered collar. It is not affected by perspiration; for it will not shrink in washing. Furthermore, the fabric is so constructed along the folding or wearing edge that no undue strain or wear is placed upon the fabric along that edge.

The laundering of the present day collar is a process which requires a score of operations, and the waste and use of much starch.

Starch for laundry purposes was recently prohibited by Lord Davenport, the British food controller, for the reason that "all the potatoes and corn that the

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United Kingdom can raise are needed internally to stiffen the resistance to the Germans and none can be spared for external purposes." Right in this country hundreds of thousands of tons of food starch can be saved yearly by the elimination of starch from collars.

Nuts Equal Round Steak in Food Value

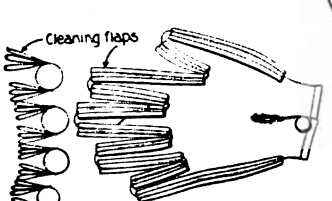
POUND for pound, walnuts, butternuts, chestnuts and hickory nuts are the equal in food value of a juicy steak, contain more protein (tissue building) food than white bread and but one-third less than eggs. In these days of food scarcity and high prices, it is likely that the vast crop of native American nuts will receive the recognition that they deserve.

The Butler's Glove Appears—A Japanese Invents It

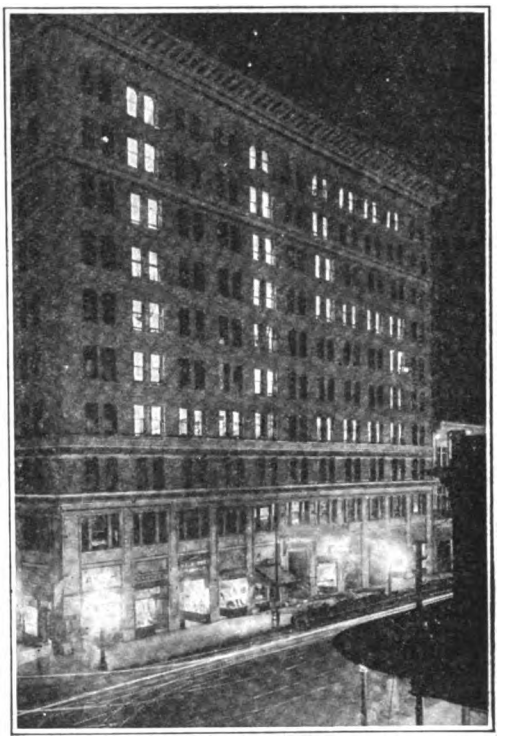
A JAPANESE in Los Angeles has patented a glove which in his opinion will prove invaluable to the "buttling" fraternity for all kinds of service where a dust cloth or polishing cloth is generally used.

The glove is made of any suitable material in the manner of an ordinary glove. Along the inner finger seams are a series of parallel flexible plaits, arranged three to the seam. These are attached so that they can be put aside when it is desired to grasp anything with the fingers.

The gloves are simply slipped on, and the polishing is done with the hands. Of course, we presume that the same glove will not be used to polish boots and silver, so that a number of pairs will be required.



A butler's glove made of soft material for polishing things



Patriotic illumination of office windows in Fresno, California, showing the initials of Uncle Sam's glorious name

"U. S." Spelled by the Illuminated Windows of an Office Building

FOR the Fourth of July or other patriotic celebration many cities might well copy the plan devised by an ingenious Californian who lighted up the windows of one of the large office buildings so as to form on a large scale the letters "U. S." The only requirement was the lighting up of the proper rooms in the building. A thousand watt lamp for each room sufficed. A few of the offices which were not required for the display and which had to be used were effectively blotted out by drawing the shades closely.

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The Farmers' Motor Express

How motor trucks help to solve the food problem in Maryland by making the return trip profitable

By Joseph Brinker

The tagged can will be picked up by the truck

THE motor truck, operated as a rural express carrier, promises to contribute materially to the solution of the food problem and of some other difficult problems, which owe their origin to the existing war conditions. The system has already been tried out in Maryland with results which are highly satisfactory.

Rural Express Companies Are Licensed

The Maryland Public Service Commission issues exclusive licenses to truck owners to operate their vehicles over certain fixed routes, provided the owner agrees to maintain the schedule arranged and to increase his equipment, if necessary, to carry all the goods offered for shipment on his particular route. If the route holder subsequently fails to meet these conditions, his franchise is taken away by the commissioners and given to another contractor.

At this writing there are not less than twenty-three such rural express companies operating on as many Maryland routes. They employ thirty-one motor trucks, which, together, cover daily on an average 588 miles and carry seventy-five tons of farm products. The longest route is that between Fredericksburg and Baltimore, a distance of forty-seven miles.

Solving Washington's Food Problem

Some of the routes run from the rich agricultural districts of Maryland to Washington, where the food situation has become very acute. The population of Washington has increased by one hundred thousand during the past year, but the facilities for bringing food to the capital has not been adequately enlarged. There was food enough within fifty miles from the city, but before the introduction of the rural express motor trucks it was practically inaccessible. Maryland's routes have proved so successful in carrying food products of every kind, such as butter, eggs, milk, green vegetables and even live stock, from the farms directly to the markets in the city, that additional routes are being operated to bring the farm products of the rich country in northern Virginia to the markets in Washington. The trucks, returning from the city, take back loads of goods needed by the farmers. Hence trucking is made more profitable and efficient and more attractive for both sides.

Picking Up Live Freight in Passing

The great variety of things which these trucks collect along their route for transportation to the city is astonishing. At the first stop the driver may find a hog awaiting his coming. The animal is tied to a stake and has a tag with name and address of the sender and the destination of the live freight tied to its neck or tail. At the next farm the truck's load may be increased by a properly tagged calf and a crate of chickens or geese. A basket of eggs and perhaps a hog or two may be the contribution of the neighboring farm. The next may contribute a few tubs of butter and a crate of cheeses. All along the road the driver finds Y-shaped posts. Suspended from the crotch of the post there is almost invariably a tagged can filled with milk or cream destined for the city market. The driver collects these cans, loads them on his truck and on the following day brings them back empty to the sender. When shipments are made by railroad the farmers, as a rule, have to wait three or four days for the return of their cans.

Canned milk to be shipped to market is simply left by the farmer on the route of the express trucks, properly labelled for shipment to the city. Likewise, if a

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cow or a calf is to be transported, all that is necessary is to tag the animal and leave it tied to a post on the route, to be picked up by the express driver and carried to its destination.

Number of Handlings Are Reduced

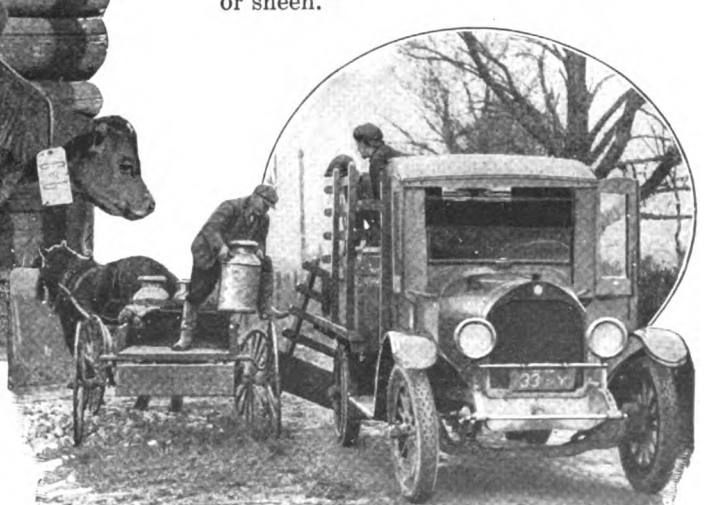
Such routes have a tendency to reduce the cost of food because they reduce the number of handlings. Each handling adds to the cost of any article, be it food or manufactured product. As an example, it requires at least fourteen handlings to get a case of eggs from Vineland, N. J., to New York city by present rail express routes. First there is a haul from the farm to the railroad station; then comes loading upon the express cars, followed by transferring the goods from one line to another. When the produce reaches New York, there is a haul to the wholesaler from the railroad station and another to the final consumer. By truck, these fourteen operations are reduced to two, from the original producer to the final consumer, with only six persons handling the goods. As another example, mushroom growers in Oxford, Pa., had to ship their goods one hundred and ten miles by rail to get it to Philadelphia in about two days or forty-eight hours. By the rural express truck, the road distance between the two points is only fifty-five miles or just half, and the run can be made from the grower to the eater in about four hours or one-twelfth the time.

Your Silk Socks May Once Have Been a Tree

THE method by which most of the artificial or imitation silk is made at the present day, the so-called viscous process, was invented by two English chemists, C. F. Cross and E. J. Bevan. As the basis of this process there is used wood pulp, prepared by the maceration and chemical treatment of wood. This pulp is treated with a solution of caustic soda and then with the liquid called carbon disulphide, whereby a thick syrup-like mass is obtained. By forcing this viscous material through minute apertures into a suitable liquid, silky filaments are produced which can be spun into fine or coarse threads suitable for knitting or weaving.

But, we are cautioned, in Alexander Findlay's "Chemistry in the Service of Man" (Longmans, Green & Co.) this artificial silk must not be confused with the lustrous material known as mercerized cotton, so-called after the discoverer of the process, John Mercer. "Cotton, in its natural state, consists of flat, twisted fibers, but when these fibers, tightly stretched, are immersed in a solution of caustic soda or soda lye, the fibers swell up, become untwisted, and assume a nearly straight, rod-like form. The surface of these fibers is covered with a number of smooth ridges which, reflecting the light falling on them at different angles, give rise to a lustrous appearance or sheen."

Bossy will be picked up and transported to his destination



A load of milk being transferred to the express motor truck

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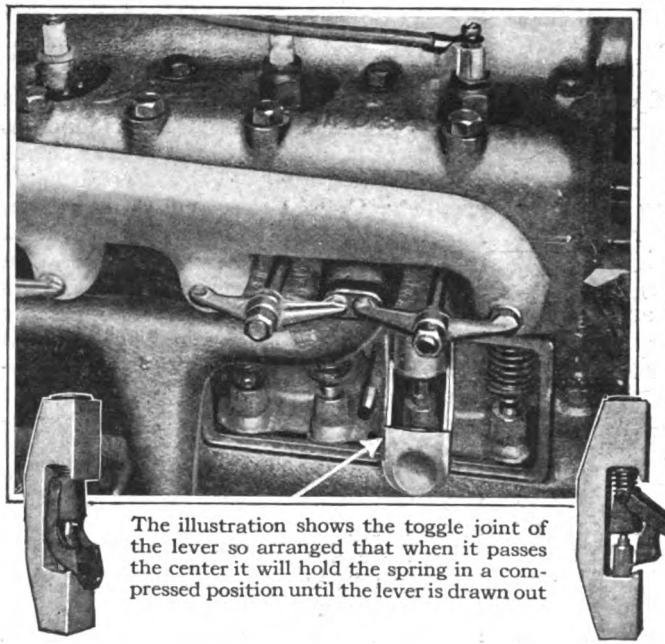


The illustration shows the toggle joint of the lever so arranged that when it passes the center it will hold the spring in a compressed position until the lever is drawn out

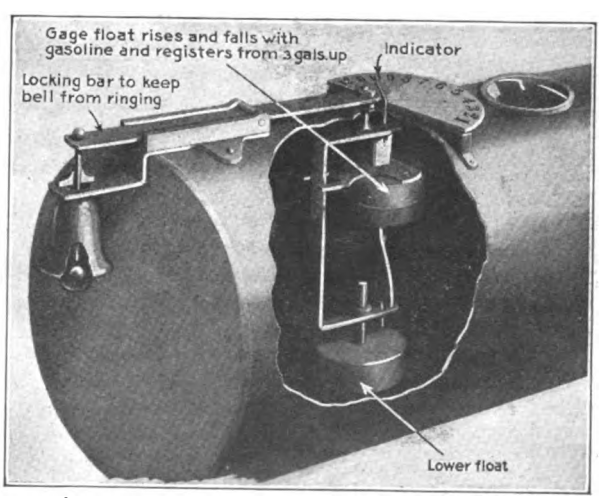
New Tool Makes Ford Valve Removal Easy

THIS lever-principle tool automatically compresses the Ford valve spring when pushed down, so that the pin at the bottom of the valve stem can be removed easily and the valve taken out for grinding. The cup-shaped part placed around the spring keeps the latter in a compressed condition until the valve is put back. The toggle joint of the lever is so arranged that when it passes the center it will hold the spring in a compressed position until the lever is drawn out. Being made of light sheet stock one or two of these can be carried in the tool box ready for any emergency. It certainly is a handy tool to have.

When Your Gasoline Gets Low the Bell Will Ring

REV. R. A. GOODWIN, of New Hampshire, has invented an attachment for registering the amount of gasoline in the tank of an automobile, and also for ringing an alarm bell when a predetermined minimum of two or three gallons has been reached.

The device consists of two floats in an adjustable iron frame in the gasoline tank, and an indicator and bell outside. The upper float in the tank rests on the surface of the gasoline, and is connected with the frame so that it cannot itself rotate, but communicates its motion to the indicator through a metal spiral with a half-turn in it. The alarm mechanism is worked by the lower float. The mechanism consists of a bar, pivoted on the top of the tank, and carrying the bell-clapper at one end. The clapper is provided with a collar so that it can seat on the top of the bell and be rendered thus immovable. The other end of the bar, which extends a little beyond the pivot, is attached to the frame inside the tank. To the bottom of this is attached the second float, which can be screwed up and down a scale, graduated by experiment. As soon as the level falls below a certain point the float drops, the weight of the framework unseats the bell-clapper, which sounds an alarm with the jolting of the car.



An upper gage float resting on the gasoline actuates an indicator, while the lower works the alarm

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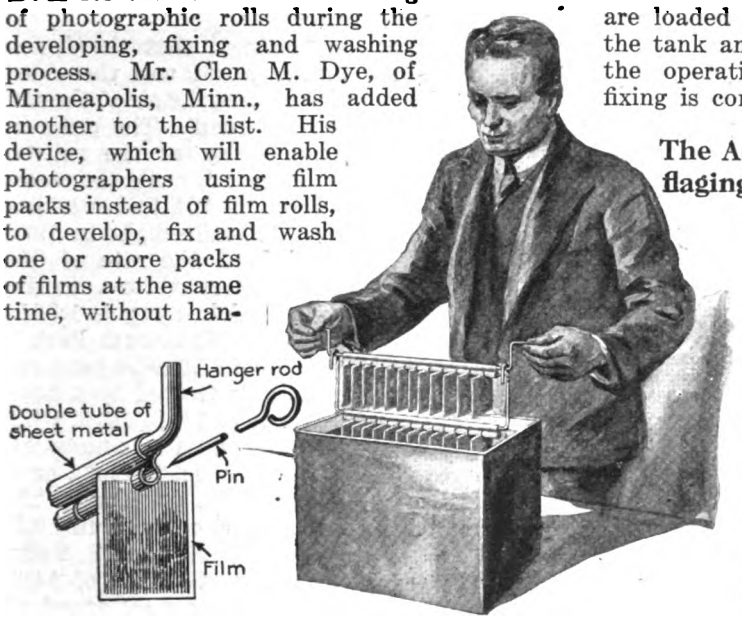
Developing, Fixing and Washing Several Film Packs at One Time

MANY devices have been invented for the convenient handling of photographic rolls during the developing, fixing and washing process. Mr. Clen M. Dye, of Minneapolis, Minn., has added another to the list. His device, which will enable photographers using film packs instead of film rolls, to develop, fix and wash one or more packs of films at the same time, without handling each individual film separately.



A device useful to photographers who desire to develop, fix, and wash several packs of films simultaneously and quickly

A wire rod, bent so that its arms rest on the edge of the developing or fixing tank, is the support of the film-holding device. To this rod a tube is soldered, through which a long, thin pin can be pushed. The tube is provided with a number of slits, wide enough to accommodate the thickness of a film.

To load the holder, the pin is removed. After the first film has been inserted the pin is pushed in so as to pierce the edge of the film. Then the next film is placed in the second slit and the pin pushed through its edge. This operation is repeated until each slit contains a film These films are held in place by the thin pin upon which they are strung. Supplemental sections, similarly arranged to hold a number of films, may be loaded and suspended from the main section of the holder. After all the holders are loaded they are immersed in the tank and left suspended until the operation of developing or fixing is completed.

The Advantage of Camouflaging Transatlantic Ships

THE ship that is well camouflaged, that has no masts or funnels, that is driven by oil engines instead of steam, furnishes a poor target for the U-boat. It has been estimated that if all transoceanic ships were thus disguised, our enemies would need at least fifty submarines to patrol effectively a sea lane five hundred miles wide.

Spineless Cactus Leaves Become Attractive Sign-Boards

A LOS ANGELES nurseryman, who has an agency for the supply of spineless cactus, used as cattle feed, has hit on a novel method of advertising his wares. The plants themselves serve as a signboard, the advertising matter being written on the leaves. The passers-by read and then stop and feel the leaves to see that they are really spineless. As the illustration shows, the nurseryman is a first-class advertiser but a second-rate speller. In spite of this simplified spelling he has made his business flourish like his cactus.

Spineless cactus leaves are nutritious and palatable food for cattle

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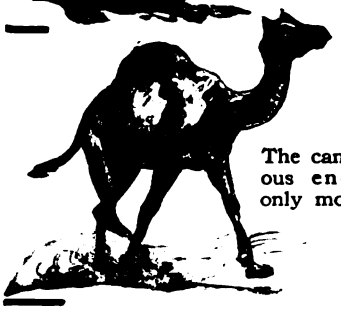
With Fin, Foot and Wing

Records of the swiftest animals

By Clifton Harby Levy

The snail easily holds the record for slowness of progress

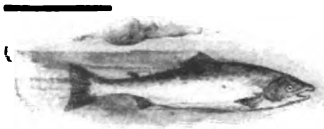
Next comes the tortoise, famous for slowness in ancient Greece



The camel has marvelous endurance but only moderate speed

Santa's reindeer travel only about ten feet a second

The grasshopper in his jumps can make thirteen feet a second and not feel it



The salmon travels in the water at double the speed of a grasshopper

Man has been known to make as much as thirty feet a second in sprinting

But he cannot rival the antelope with its speed of forty feet or more for each second

IT was long claimed that the fastest animal in the world was the eider-duck, which cleaves the air at the rate of 150 feet each second. The ordinary wild-duck travels only at the rate of seventy feet per second, while the record of a carrier-pigeon is 124 feet a second established in a 100-mile flight in 1900. The bird traveled at the rate of 85.6 miles per hour. The record for a running horse on a mile straight-away is 1:35½, made by Salvator at Monmouth Park in 1890, or at the rate of 37.6 miles per hour. The fastest mile ever trotted by a horse was done by Uhlan (1:58) in 1912, while the fastest mile ever paced by a horse was done by Dan Patch in 1:55 (1906), or at the rate of 32.43 miles per hour. The record for a human mile over a full mile track is that made by Norman S. Tabor (1915) 4:12 3/5 or at the rate of 14:24 miles per hour. The greatest speed attained by any man is that of Howard P. Drew, who covered 100 yards in 9 3/5 seconds (March 28, 1914).

If Men Could Only Jump Like Fleas

If a man is to be compared with an insect in getting over the ground we shall have to mention the record jumps made by athletes, and note what the flea and grasshopper can do. R. C. Ewry has jumped 11 feet 4⅞ inches (standing broad jump) and 4 feet 11 inches (standing high-jump), but M. Prinstein covered 24 feet 1 inch in the running broad jump and S. S. Jones made 5 feet 11 inches in the running high jump. Prinstein also holds the record for the hop-step-and-jump (47 feet).

The flea jumps farthest in proportion

Where will they be at the end of a second? The black lines

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to its size of any living animal, covering 200 times its length in a single jump. The speed with which it jumps has been measured as 9 feet 1 inch per second. But this speed has been surpassed by a small grasshopper without wings which measured only 0.273 inch and sprang into the air at a speed of 13 feet per second. Winged grasshoppers one inch long have been known to jump 15.6 inches high and 23.4 inches wide, or at the speed of 13 feet per second.

Man makes slowest progress of all in the water. The fastest swimmer, B. Kiernan, made a mile in 23:16 4/5, or at the rate of 2:65 miles per hour (3.7 feet per second). An English zoölogist claims that a salmon swims at the rate of 26.28 feet per second. It is estimated by those who have made a special study of fish and their speed in the water that most fish swim a yard or more a second. It has been possible to measure with considerable exactness the speed at which a whale can swim, by timing the running of a harpoon-line after a whale has been "struck." In this way it has been shown that a whale goes at the rate of between 10 and 15 feet a second.

Crabs Not Famous for Their Speed

A crab travels sidewise at the rate of 2.73 inches per second, unless frightened, when its speed is increased. A lobster travels more or less sidewise like a crab at a rate of 5.85 inches per second. A tadpole, half an inch long, swims 4.29 inches per second, and when an inch long swims 6.63 inches per second. A swan, when frightened or pursued, makes its way through the water at a rate of 44 inches each second.

Attempts have been made to train swallows as letter-carriers, on account of their great speed. It was claimed that in one race between a swallow and a carrier-pigeon the swallow flew four times as fast as the pigeon. The accuracy of this test has been questioned.

The Swallow Holds the Record for Speed

It has been proved, however, that the swallow does fly faster even than the eider-duck, cleaving the air at between 210 and 333 feet per second. This being so, it must be the fastest moving animal in the world, unless the unconfirmed figures of individual naturalists are to be accepted. Some claim that the blue-throated warbler travels at a rate of 363 feet a second, and the plover as fast as 436 feet a second. The Virginia rain-plover, it is asserted, traveled from Labrador to Brazil in one night, a distance of 800 geographical miles, or at the rate of 450 feet a second, the greatest speed claimed for any living creature.

The eagle crawls along by comparison, attaining no more than 75 feet per second, while cranes far outstrip them traveling 165 feet per second.

The Speed of the Soaring Birds

The soaring flight of birds, without flapping the wings, is directly dependent upon the spread of wing as related to the weight of the body. It has been found that the soaring ability of various birds is at the following speeds: Swallows, 9 to 11 feet per second; herons, 12 to 14 feet per second; cranes, 15 to 17 feet; silver-gulls, 16 to 18 feet; albatross, the greatest soarer of all, 20 to 23 feet per second.

The number of strokes of the wing, or flaps has also been studied and recorded, showing the following number per second: Fly, 330; humming-bird, 240; bee, 190; wasp, 110; sparrow, 13; wild-duck, 9; house-pigeon, 8; mouse-buzzard, 3.

It has been ascertained by careful observation that swarms of butterflies progress at a rate of from 35 to 39 feet per second. When flying quietly around a room a fly covers from 4 feet to 22 feet per second, but if pursued may fly as fast as 58 feet a second. A bat averages about 30 feet a second, and a flying fish covers 81 feet a second.

The record for a mile walk by a man was made in 1910, being 6:25 4/5, but

One hundred and fifty feet a second make the eider-duck one of the fastest creatures that we have any record of

But the swiftest of them all is the swallow with an average recorded speed of two hundred and fifty feet per second

by their length show the relative speeds of different animals

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the average speed at which a man walks is not over three miles an hour. It has been estimated that a man weighing 150 pounds may cover 5 feet a second, without feeling great fatigue, for hours at a time, if in fair condition.

The Snail the Slowest of All

The slowest of all animals, as has been popularly believed, is the snail, which travels .06474 inch per second, taking five minutes to go 1.65 feet. In an hour it will go about seventeen feet, according to another authority. A little spider covers 2½ inches a second and a large one 4 inches. It has been noted that a spider, travelling over its tracks three times, spins a web at the rate of .11 inch per second. Larger spiders have reached a speed of 5 inches a second. The ordinary rain or earth-worm creeps .11 inch per second, and if pursued may triple this speed, or advance .33 inch per second. The ordinary black ant (*Latius niger*) moves at the rate of 4/5 inch per second when going about its regular affairs, but if pursued or frightened may cover 3 inches per second. The silk-worm spins a cocoon 991 feet long in 7 to 8 days, or at the rate of 130 feet a day. A rattle-snake moves over the ground ordinarily at a rate of 4 inches per second, but when pursuing its prey may go 20 to 40 inches per second. A rattle-snake 20 inches long, ¾ inch in diameter, has been observed to swallow several frogs 3 inches long and 1½ inch in diameter at the rate of one frog in twenty-four minutes. The frog usually moves at a rate of 3 inches per second, so he falls an easy prey to the swifter snake. A toad hops at the rate of 8 inches per second.

The Tortoise—a Classic Example of Slowness

The tortoise, 5 inches long, travels from .30 to .78 inch per second; a tortoise twice the size covers 1.5 inch per second; while the giant tortoise scrambles along at a rate of 2.8 inches per second. The hare, so often compared with the tortoise, especially in the famous fable, when doing his best may cover 60 feet a second. A reindeer, when drawing a sled, covers 10 feet a second, but a wild roe pursued by two dogs has been known to get over the ground at a rate of 74 feet a second. The antelope has no difficulty in going from 40 to 47 feet a second, but a tiger has been said to cover a short distance at the rate of 46 feet a second. The greatest speed of a wolf is set down as 30 feet a second. A fox travels something like 50 or 60 feet a second, when pursued. The record of English fox-hounds is 60 feet per second, and the fox kept ahead of them. Ordinary hunting-dogs usually attain a speed of between 33 and 45 feet per second.

Slow, but Sure, Is the Motion of the Ox

The ox is not famous for speed, being often compared with the snail, but when pulling a plow he goes at a speed of 23.5 inches per second and when pulling a wagon, at a rate of 29.4 inches per second. The elephant when running wild may cover twenty feet a second, but when trained will pull a heavy load at the rate of 4 to 5 feet a second, on account of his great stride. A dromedary has been known to cover 86.8 miles in a day of 16 hours. Brehm, the German naturalist, claims a record for some dromedaries of 119.73 miles per day, and states that the ordinary speed for a properly equipped caravan is about 25 miles a day.

Naming Trenches After Manhattan's Streets and Avenues

It must have been the trench-like condition of the streets of Manhattan during the progress of constructing the subway systems that suggested the propriety of naming the trenches of the training camp at Spartanburg, S. C., after the streets and avenues of New York city. Under that system the battery positions are regarded as the South end of Manhattan Island; hence this general locality is known as Battery Place. The reserve trench is known as Wall Street, the two supporting trenches as Forty-second Street and Fifty-ninth Street and the two fire trenches as 116th and 125th Street. The foreground, or No Man's Land, is the Bronx. The leading artery of approach is known as Broadway. East of it follow Fifth, Third, Second and First Avenues, west of it Tenth and Eleventh Avenues. Diagonal trenches are named after Park Avenue, Columbus Avenue, etc., and the short ones are named after some distinguished American soldiers.

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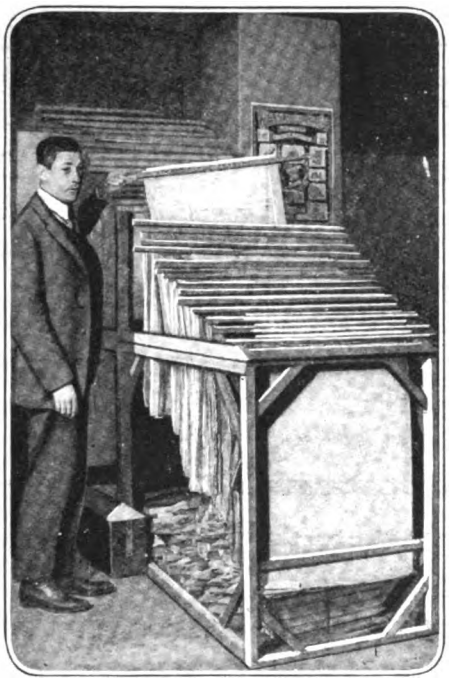
Storing Maps and Plans in an Ingenious Rack

As county engineer of Erie County, New York, Mr. George C. Diehl naturally has to keep by him for immediate reference a large number of road plans, maps, etc. Finding that the number was growing out of all proportion to the space at his disposal, he cast about for a more compact means of storing them. The rack which our illustration depicts was the result.



A handy way of keeping mounted maps so they can be got at with a minimum of effort and trouble

It is merely a framework of two by four lumber, with the top rail sloped at an angle of about thirty degrees. Pegs are driven into this top rail at intervals of about two inches. The maps and plans are clipped between two laths along one edge, and the titles are written plainly on the laths. The mounted map is then placed in the rack, and the laths scotched behind a pair of the pegs. Kept in this way the titles can be readily scanned, and the maps are available for immediate use. In addition they take up much less space in the office than if they were just piled up promiscuously.

An improvement to this contrivance may be suggested after a glance at the illustration here presented. To prevent dust from getting onto the maps it may be well to box in the sides with cloth or canvas and contrive a movable cover of the same materials for the top that may be raised or lowered.

A Pencil That Will Write Your Name on Your Shears

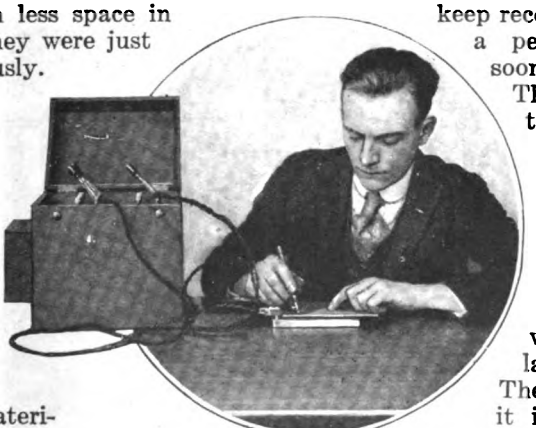
The office worker whose shears or paper-knife disappears mysteriously sometimes to reappear on the desk of another, sometimes to vanish altogether, will welcome the electrical engraver. It is a device which will enable him to write his name—just as he would use a pen or pencil—on any article of steel.

In an oak case is a transformer, the primary circuit of which is connected with a source of alternating current. A special resistance is inserted in the secondary or lighting circuit to regulate the depth of the engraving.

Connection is made with the pencil and the metal plate on which the object to be engraved is placed. Bringing the copper point of the pencil into contact with the steel completes the circuit. Intense heat is generated at the pencil point with the result that the steel is burned away wherever it is touched.

This device makes it possible to keep records on cuts where a pen notation would soon be obliterated.

There can be no question of its value to the jeweler or the professional engraver, who will doubtless welcome the advent of a new and efficient instrument that will render their labor much easier. The ease with which it is operated is an additional recommendation.



You engrave your name on steel as easily as you write with pen and ink

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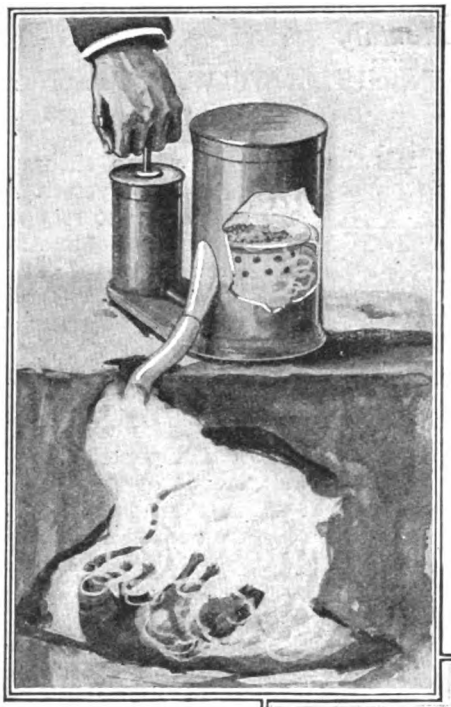
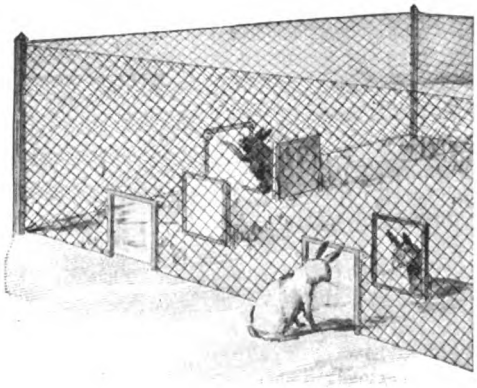
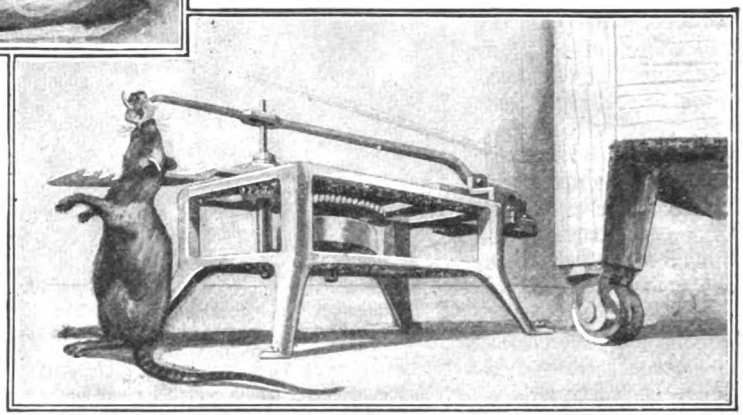
When Man Plays the Role of Hun in His Warfare Against Rats

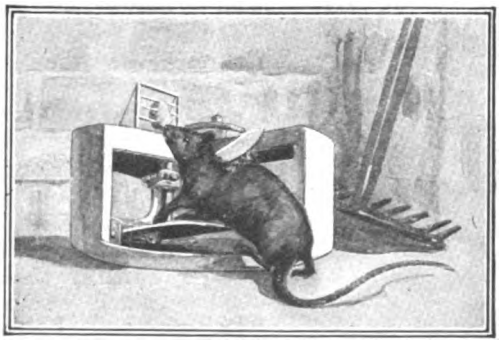




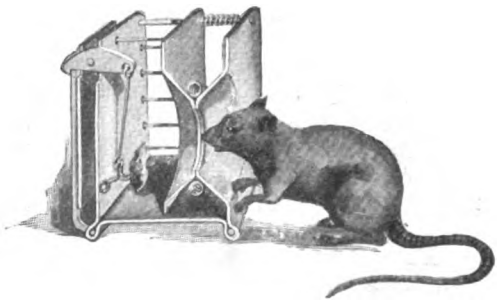
Poisonous gases of combustion, generated in the portable stove, are forced into the rat holes by an air pump, killing the rats. This gives rise to another problem, i. e., how to get the dead rodents out of their holes



When the rat nibbles it is killed and flung away by a spring-propelled saw-tooth arm which is automatically reset



Here a spring-propelled rotary knife beheads the unsuspecting rat neatly and painlessly when it tries to reach the bait



This shows the hungry rat poking its head into the funnel-shaped opening, shown here in cross section, and losing its head

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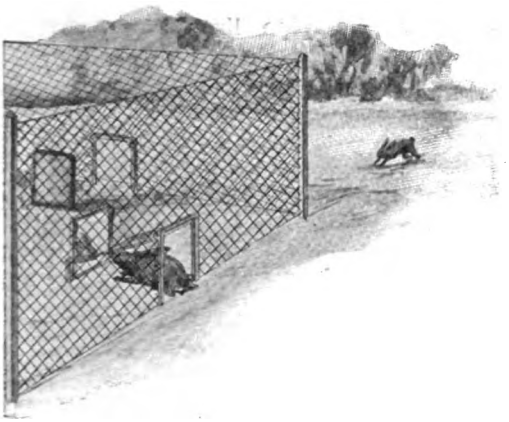
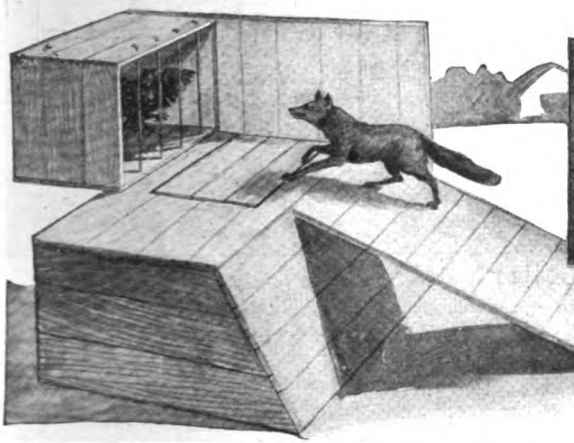
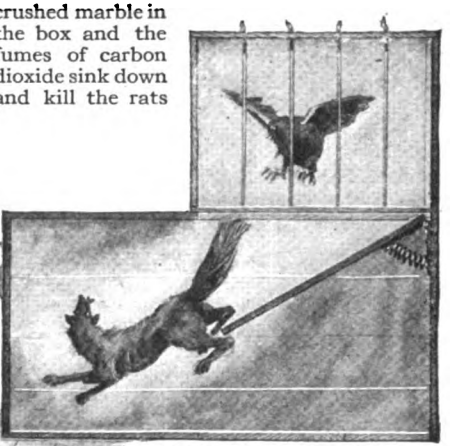
He Gases Them and Traps Them in Regular Teutonic Fashion



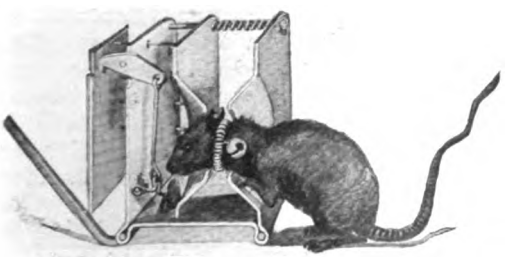
The rabbit, longing for society, sees his reflection in the mirror, enters through the swinging glass door and is a prisoner

A blow breaks the bottle, the acid runs over the crushed marble in the box and the fumes of carbon dioxide sink down and kill the rats





Reddy the fox would like the chicken, so temptingly within reach, for his dinner. Up he goes and approaches his goal. Then something unexpected happens. The trapdoor gives way and Reddy is **caught like the hero of a blood-curdling melodrama**



As he touches the bait, the two ring-shaped sections separate and a spring collar with bells slips around the rat's neck

When he returns to his family with this noisy ornament, thus forced upon him, he will cause a good-sized wild stampede

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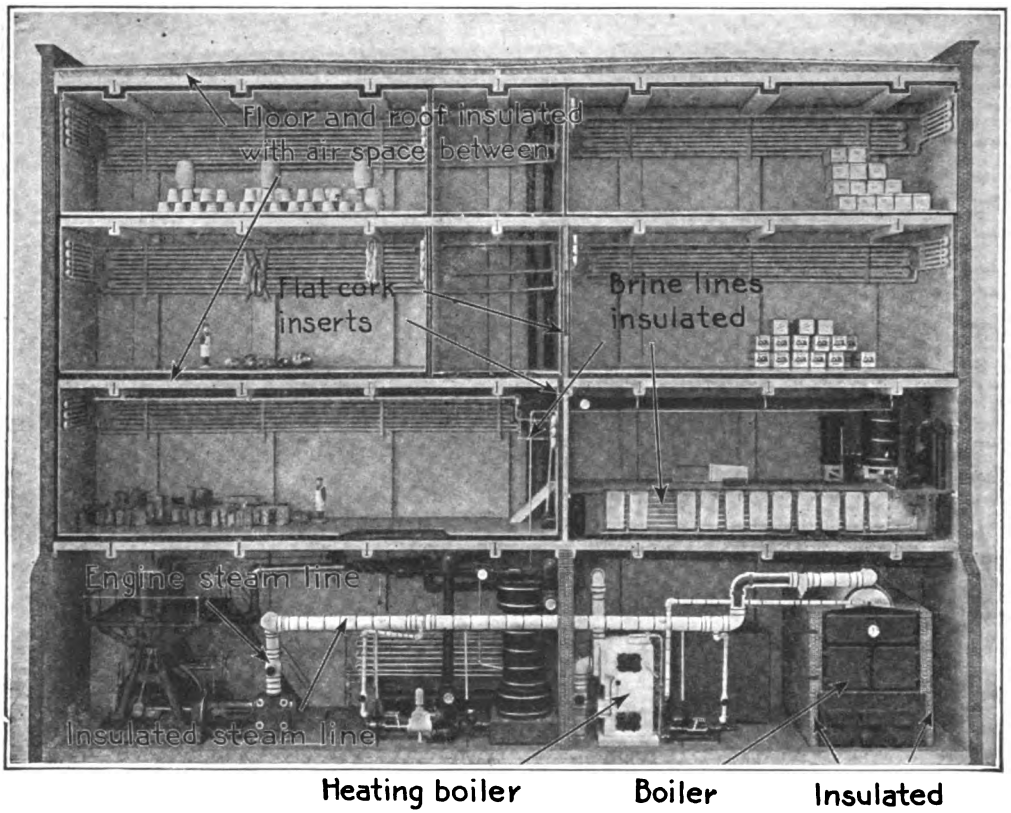
Keeping Out Heat

Insulation is the great problem in cold storage—How cork is used to cover the pipe lines



This cross section of a modern cold storage warehouse shows clearly the method employed for insulating the cooling spaces against the intrusion of unwelcome heat from the outside

IT is a fact, although not generally well known, that three-quarters of the work of the refrigerating machine in any cold storage plant is spent in removing or neutralizing the heat that seeps in through the floors, walls and ceilings. Only one-fourth the work is spent to cool the goods in storage. If ice is used, seventy-five pounds out of every hundred put into the cooler is melted by the heat that comes in from all sides. That is clearly an enormous waste which demands prompt attention.

The importance of wall, ceiling and floor insulation at once becomes patent. The method of keeping a great percentage of this warm air out is clearly shown in the accompanying cross-sectional view of a modern cold storage warehouse of three stories and basement.

Beginning way down in the cellar, even the steam lines, feed water heaters, boilers and the plant auxiliaries are insulated, as are all the floors, walls and ceilings. The brine coolers and brine pipe lines are similarly covered. Sometimes cork is used to keep the cold in and the heat out. It is made up into semi-cylindrical strips for the pipes and in flat board-like pieces for the walls and ceilings. In the case of concrete floors, the cork insulation is placed directly on top of the wooden forms before the concrete is poured into them.

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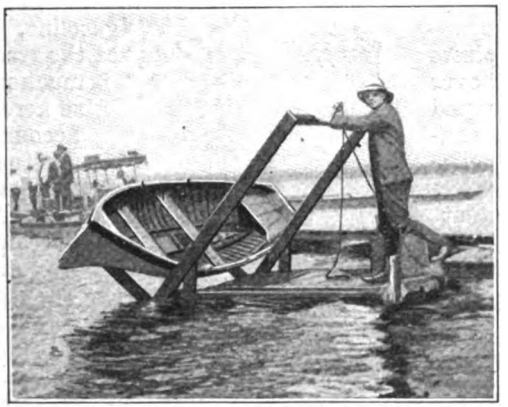
Washing Machine for Boats. It Does the Work of Two Men

NO electric motor is attached to the boat-washing machine, but the device, as perfected by a liveryman of Devil's Lake, Michigan, is just as useful as an elaborate washing machine of any kind.

The machine consists of two beams four-inches square, held a few inches under the water and attached to a lever made of two two-by-four beams, which, when the machine is in position to receive the rowboat, stand almost upright. Attached to these levers is a block and tackle used in the first part of the operation of placing the boat in position for washing.



The boat is lifted out of the water for a good cleaning, and one man can do the job

In use the boat is floated onto the two submerged beams, the block and tackle is put into action and the boat lifted out of the water and turned over on its side. In this position it is easily cleaned.

Bumping the Bumps for the Fun and the Exhilaration It Gives

NOTHING makes a playground more attractive for the kiddies than one of these wavy coaster slides shown in the picture. In two lines the children file up the divided stairs. Having reached the platform at the top, they slide down again on one of the two slides which lead to the ground in opposite directions. What fun! Quickly the little ones descend upon the smooth surface of the sliding trough, and the bumps they get in passing over the tops of the gentle waves add to the zest and exhilaration of their pastime. Glowing with excitement and pleasure the children return to the stairs for another turn at the slide, and they never seem to tire of the sport.

But, even older and really old persons are by no means proof against the allurements of this form of amusement.

Sit down, slide down, come down! The bumps give you the ups-and-downs of life. If you are old, they make you feel young. If you are young, they enhance your enjoyment of life

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A Coat of Mail? No, It's a Canvas Shield for the Iceman

THE lithe Italian who handles ice in summer and coal in winter does so with utter disregard of wet and dirt. Charles G. Sagerstrom, of Chicago, is trying to market a shield for protecting the iceman's clothes. This shield consists of two waterproof breast pieces which are thrown over one shoulder and strapped into place. A double canvas shoulder strap connects the two pieces at the top. The steel epaulet has teeth cut into it to prevent the burden from slipping.

Keeping his shoulder dry with the new protector

Gasifying Kerosene in the Farm Tractor

ALL motor-vehicle and motor-tractor owners would like to use kerosene as a fuel instead of gasoline because of the cheapness of kerosene as compared with gasoline. Unfortunately, engineers and inventors have not been able to design satisfactory means whereby kerosene can be burned with as good results as gasoline.

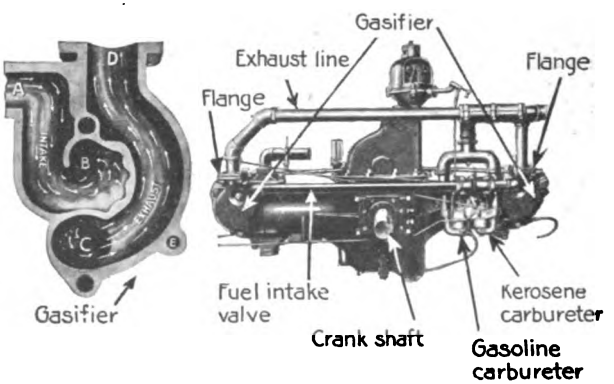
The trouble is that the kerosene can not be entirely vaporized, that is, turned from a liquid into a gaseous state. Kerosene is heavier than gasoline.

Then again, kerosene has some constituents which vaporize at one temperature and others at a still higher temperature so that unless the maximum amount of heat is supplied to vaporize the least-volatile portions, they get into the engine as fluids and destroy the engine lubricants by working down past the pistons into the oil reservoir in the engine crankcase. Even if some of these liquid portions are burned, they do not give up the same amount of power as when mixed with air to form an explosive mixture and result in carbon deposits.

While the problem of burning kerosene in internal-combustion engines on farm tractors is by no means solved, the gasifier shown in the accompanying illustrations gives fairly good results. The use of kerosene, even with the gasifier shown, is not as economical as gasoline, as was demonstrated at the tractor trials of 1917. It is much more difficult to vaporize kerosene than gasoline on account of the heavier constituents of the former fuel. Heat applied to kerosene will assist it to break up into a gas more readily, and this is just the principle of operation of the gasifier shown.

The device consists of an irregularly-shaped hollow casting fitted to the head of each of the two horizontal engine cylinders. The casting is divided into two main parts, as shown in the sectional illustration, by means of a thin serrated wall. The hot exhaust gases pass out on one side of the wall, heating it so that the fuel, which enters on the other side, is heated and gasified before passing into the cylinders.

The substitution of kerosene for gasoline is simply a question of comparative cost. Does this gasifier, which must be expensive, solve the problem?



With a sufficient heat supply this gasifier makes kerosene available as automobile fuel

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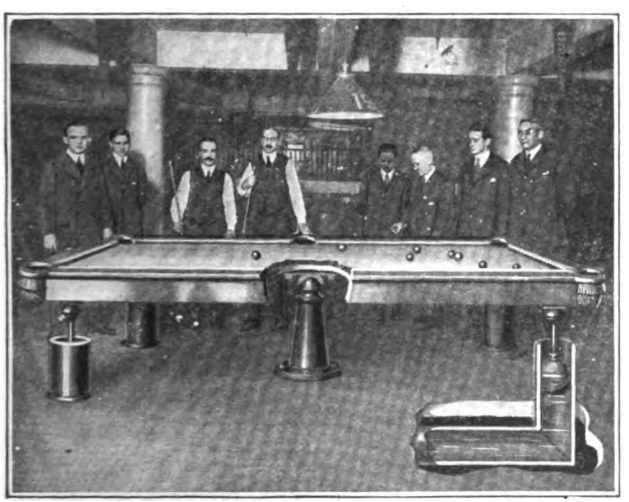
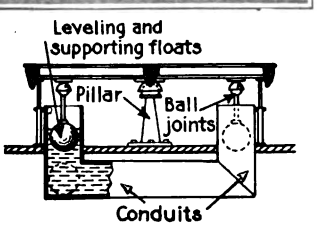
Ship's Billiard Table Like a Carpenter's Level

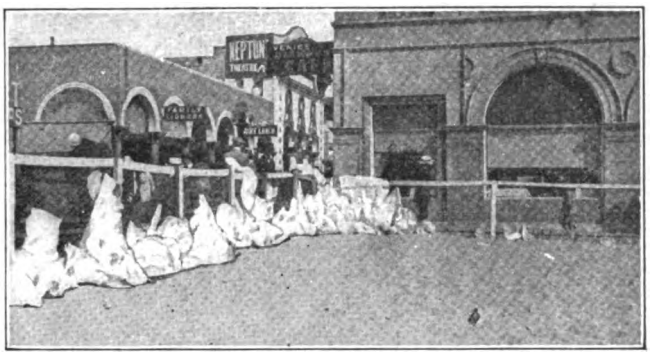
JOHN FRANCIS BOOTH, of New Zealand, has obtained a patent upon a device invented by him, in which he makes use of the principle of the spirit level to give a billiard table on board of a ship a horizontal level undisturbed by the rolling and pitching of the ship.

In its center the table is supported by a pillar, the top of which has a ball and socket joint. Beneath each corner of the table is a vertical cylinder, filled with water, and these four cylinders are interconnected by conduits of a cross-sectional area equal to that of the cylinders. Extending downward from each corner of the table is a vertical bar which has at its lower end a float slightly smaller in diameter than the cylinder. These floats rest upon the water in the cylinders and communicate the changes of level to the table. This billiard table will be appreciated by travelers who are fond of billiards, but can't stand the ship's pitching.





Cross section of billiard table showing the arrangement of the supporting floats. In the diagram is shown how the cylinders are arranged; also the ball-and-socket support in the center and the vertical bars



Showing how waste-paper is prevented from blowing about at random by a wire fence high enough to keep it confined

Building a Fence to Keep Out the Old Newspapers

AT one of the popular resorts, during the season, the proprietors of the various restaurants and beach establishments found that they were suffering from an invasion—not from anything of flesh and blood, it is true, but from newspapers. The wind blew up the old papers left lying on the beach by visitors, and littered up the open spaces. To cope with the nuisance and repel the invaders, battlements of wire netting were erected along the edge of the boardwalk. Here the would-be invaders rustle and crackle in vain, as our illustration shows.

Aside from the unsightliness of such fluttering paper; there is a real hygienic reason why old newspapers should be prevented from blowing about, as they have gathered filth as they went along.

Wood Fiber Used in the Making of Gas

IN France and Switzerland sawdust and wood have lately been experimented with for gas-making. Ten per cent of sawdust added to coal, it is reported, has given good results in Geneva; and logs of wood have likewise proved satisfactory for the same purpose. Condemned flour was carbonized at Royan and produced a good quality of coke.

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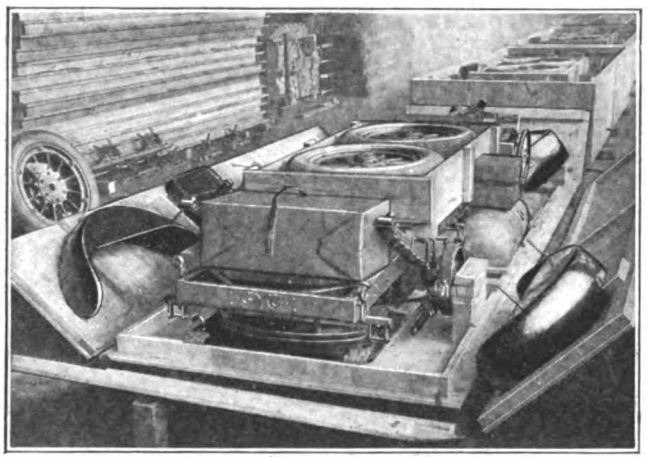


To save space army motor trucks are packed for shipment to French seaports within a narrow compass

most ingenious manner. The springs are disconnected at their ends, but not at the axles; the driver's seat, the gasoline tank and the wheels are crated separately; the engine is left in its place in the frame, but is well protected and the axles are securely chocked.

The accompanying illustration giving a clear idea of the manner in which an army truck is taken apart, crated and stowed in the hold of a ship shows how valuable space is saved by Yankee ingenuity when spurred on by necessity.

How Motor Trucks Are Packed to Save Shipping Space

THE scarcity of cargo space in our transatlantic steamships confronted the Government with the important problem whether it would be best to ship our army trucks across the ocean comcompletely mounted or to take them to pieces and pack them in boxes. The problem resolved itself into the question whether the saving of space pays for the cost of boxing and for the expense and loss of time connected with unmounting and packing on this side and unpacking and remounting on the other side of the ocean.

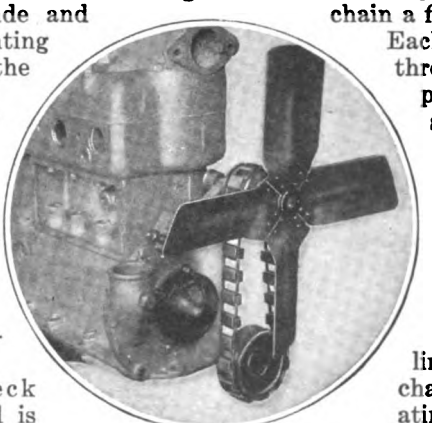
Some of our military trucks and those of our Allies are shipped completely mounted and packed between bales of hay in the hold, while others are boxed as shown in the accompanying illustration.

Especially for deck loads, the crate method is preferable, since it prevents the chassis and engine from being injured by the salt water that washes over the decks.

In packing the trucks the fenders are fastened in a

Oil, Heat and Water Do Not Affect This Engine Chain Belt

THE owner of a Ford car invented a new type of chain belt for the cooling fan, which is said to possess many advantages over the familiar leather or canvas belts heretofore used. Leather and canvas are affected by the oil, heat and water to which fan belts are invariably exposed. They stretch and have to be renewed frequently. The new chain consists of separable steel links and has leather contact plates which give to the chain a firm grip on the pulleys. Each link is composed of three parts, a wire link, a pressed steel link and a sole-leather block, which is grooved and which, when slid into place, locks the links. At the same time a friction surface of great durability is supplied. The illustration shows the individual parts of a link and the complete chain in position for operating the fan.



This shows the three parts of which each link of the new chain belt is composed

The advantage of using this chain belt instead of the old-style leather and canvas belts is obvious. Its durability more than offsets its higher cost of manufacture.

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That Dripping Varnish Brush—How to Gather Its Wipings

THE man who frequently uses varnishes or paints knows how drippings from the brush, containing hair, or cobwebs or dust contaminate the contents of the pail and prevent him from doing clean work. Even the housewife who only occasionally touches up a piece of furniture or a strip of flooring has experienced the same difficulty.

Now comes Reginald L. S. Doggett, of East Orange, N. J., with a holder so arranged that it receives the original package containing the paint or varnish. The package rests on a shoulder formed some inches above the bottom. A wide-mouthed chute or spout leads into this space, which constitutes a receiving well for the wipings from the brush. This spout has at its upper end a wiping edge so far above the edge of the holder that the wipings can not flow back into the original container.

The brush-wipings are collected at the bottom in a well that may be cleaned

Electrocuting Flies—the Newest Way of Swatting 'Em

HERE is a little device which should be installed in every home. It is a little trap made of wire and charged with current from any lighting socket. The amount of current used in killing a fly is infinitesimal—not enough to cause the slightest discomfort to a human being. When the machine is not actually engaged in electrocuting flies no current whatsoever is used. Hence the operating expense should not be much over ten cents a year.

Raw meat or sugary cake is used as bait. But the flies cannot reach it without first stepping on the "live" portion of the trap. This causes a momentary short circuit, keeling over Mr. Fly.

In case the trap is to be used at night for mosquitoes, an inside light is provided which attracts the pests.

The flies that enter this trap will be much shocked

The Self-Sacrificing Engineers of the Army

IS engineering work in the European war dangerous? This question is answered by Major-General Charles A. Clement, U. S. A., who has returned to the United States from the front. He says that the engineering work back of the salvage dumps is not extremely perilous, but if the engineer is called on to lay out a line of front line trenches, the minimum loss of lives is one hundred and fifty per cent.

"In other words," he declares, "if twenty men ordered to map out a trench go over the ground with white tape so that it can be seen at night, thirty of them will be killed before the twenty lay the work out. In credit to the engineer, be it said that there are two men to go over for every man that falls. The airplane only has them beaten fifteen per cent; one hundred and sixty-five per cent of them (the aviators) die. Airplane losses seem very small as they appear in the papers, but there are ten men on the ground for one in the air. Taking the loss of those in the air, it is one hundred and sixty-five per cent of those that first go up." The civilian should understand that the high percentage of losses is due to the reinforcement of the men originally assigned to any duty though it seems to be an incorrect statement.

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Must a Crew Row Together?

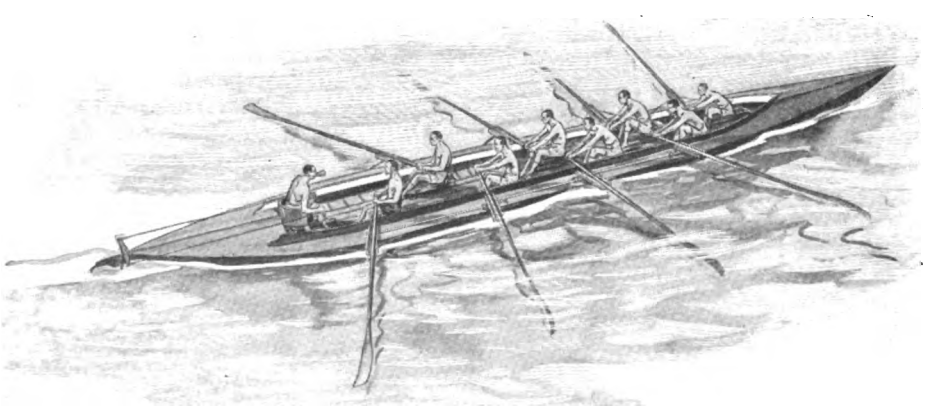
An engineer proposes a new method of racing which is based on a new principle

By Marius C. Krarup

IN ROWING a boat, the error of jerky power application which oarsmen are trying to correct is counted indispensable in the main scheme of the movement but a fault to be corrected in its details. All the oars pull together and give the boat a strong push ahead during about one-half of the power stroke, and the speed gained dies down toward the end of the stroke and while the oars are taken back through the air. Great swiftness in getting back is attempted but the musculature of man is against it, even though sliding seats are used. The waste is the same as in swimming and for the same reason. The resistance at double speed is quadrupled. The loss is so great that any boat crew that can do away with it will have an easy victory over competitors who adhere to the traditional methods. There are difficulties but they do not look insurmountable. The outrigger shell may have to go, having only a slight weight-reduction to recommend it over the more practical boat with beam enough to admit of staggering the oarsmen's seats. For a given length, the deeper displacement of the outrigger is perhaps even less favorable for speed than the skimming-dish displacement of a broader structure, total weights with the crews on board differing but a small percentage. Seats can also be spaced five inches farther apart. By such staggering and spacing each man could be somewhat behind with his stroke, following the man in front without hitting him in the back at regular intervals.

The overcoming of the seating difficulty would even bring the sport back nearer to life and open up the rougher waters, where most of the pleasure is found.

But to train a crew to row out of time on such a schedule that the stroke-oar and No. 7 are through with their power strokes just when Nos. 1 and 2 begin theirs and while 3-4 and 5-6 are at regular intermediate stages of theirs, is a more formidable undertaking than to train them to keep time with precision. Probably it cannot be done without auxiliary apparatus, and here the traditions are again in the way. Every oarsman comes to love the hip—dop, the slide and slam in the oarlocks as a criterion of skillful work. Would he consent to a change of the simple tune, a quickening of the cadence, for a 30 per cent. gain in efficiency? This would involve the re-



This picture gives an idea of the appearance of a racing shell with the crew rowing in accordance with the out-of-time plan, proposed and fully described in Mr. Krarup's article

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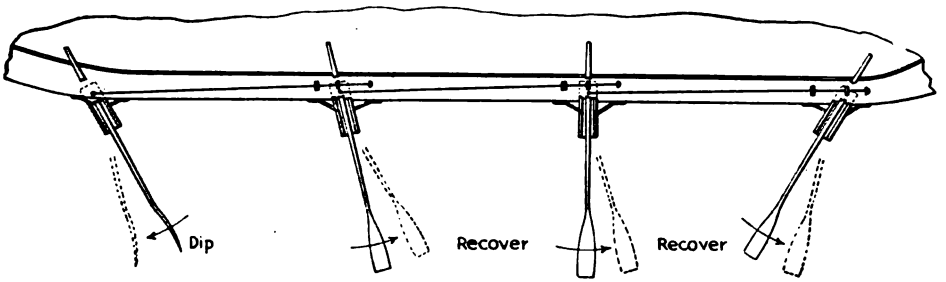
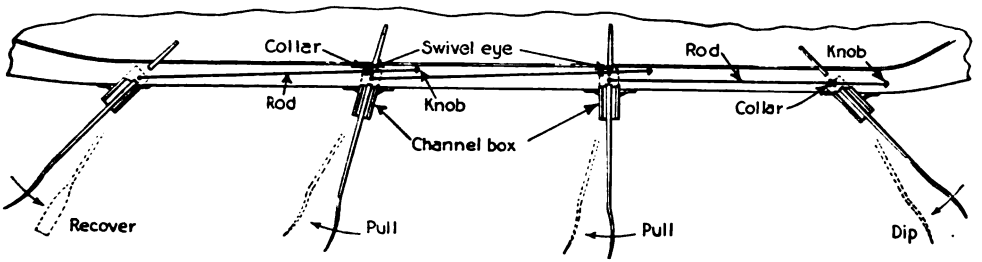


This picture and the one underneath represent two extreme positions of the oars on the starboard side of the racing shell. Oarlocks are channel-boxes pivoted to turn horizontally



In the upper position the stroke oar is at the beginning of the pull, in the one underneath, recovering after the completed pull. The knobs limit the variations of the angles of the oars

modeling of the ordinary oar-locks.

Supposing the object was to compel the keeping of time, it could be done by arranging oarlocks as shown in the pictures at the top. Each lock is a channel-box about 8 inches long pivoted at the middle so that it will turn horizontally. Under the inner end of each box there is a pin with a knob and the pins are connected from box to box by rods, free to turn on the pins. The boxes are broad enough to permit feathering. Their bottoms may be arched, as a flat bottom would interfere with up and down maneuvering of the oar in rough water. It might be an advantage to have the locks in a straight line and get away from the irrational difference in the lengths of the oars, as may be done by outrigging all the locks somewhat: 3-4 least, 1-2 and 5-6 more and 7-8 most.

It is evident that the rods would make the oars on one side turn in unison. No one on the port side could be out of time unless all of them were, but freedom for shortened stroke on either side remains; also for reversing.

By pulling his oar as far as the knobs on the rod will let it go each man can keep his place in the out-of-time schedule. Some knobs limit the variations of the angles of the oars in one direction, other knobs in the other direction. Within the limits each oar is free and training is required to make each man maintain just the angle desired, but there should be little difficulty in accomplishing this result with the auxiliary locks suggested. The plan does not work out, however, with crews of less than six, and is best for eight.

With this system the crew can row in time if that is desired. To row out of time the oars can be parallel and at right angles with the boat for the start. The stroke oar begins and the knobs successively remind numbers 6, 4 and 2 when they must start. Thereafter the knobs are not felt except slightly at the beginning and the finish of each stroke. Otherwise only when the proper cadence is broken.

Oar No. 7 keeps time with the stroke oar, as usual, and 5 with 6 and 3 with 4 and 1 with 2, besides having the knobs for guidance. The knobs must be so far apart as to permit the two extreme positions shown in the diagrams. The seats must be so far apart that these positions can be taken without clash of oars, inboard or outboard. If the knobs are placed a little too close together, there will be a slight sacrifice either in the

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continuity of the pull or in the length of the stroke, according to the option of the crew.

The gain over the keeping-time plan would with equal training amount to 33 per cent in power economy, more or less, and this would mean a 15 per cent increase in maximum speed, as the square root of 1.33 is 1.15.

The speed gain is not as great as the gain in power efficiency, and this argues for endeavoring to reduce the resistance against propulsion by all means, even before striving for continuity of the power.

A good hydroplane action, which reduces resistance greatly, depends, however, much on steadiness of the speed, and thus in one instance continuity of power and reduction of resistance are bound together. A boat rowed fast on the out-of-time plan may, if properly designed for this purpose, show a surprising amount of hydroplane action.

But after all has been said about improving rowing, if somebody suggests that the whole is a wasteful proceeding handicapped by the reciprocation and possible clash of oars, and that better results could be had by arranging to hitch up the human motors, be their number 1, 2, 4, 6, or 8, to a continuous rotating pull on one or more screw propellers, it may be hard to refute such a contention. A propeller screw operated by human power could easily be arranged to be hoisted if the water were too shallow.

Perhaps the world has rowed long enough and is waiting for a new scheme to take its place.

The Ford Delivery Wagon Can Be Used for Sunday Outings

"WHAT are you going to do Sunday afternoon?"

"I intend to take the family to my brother's farm."

"Why, that is at least sixty miles from here. How do you expect to get there and back in one afternoon?"

"Nothing simpler, in my little Ford."

"But—I did not know you had two machines!"

"I haven't!"

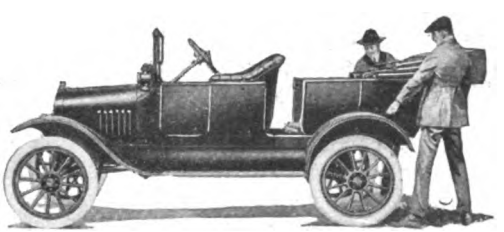
"Well, you surely aren't going to take your family in—"

"My delivery truck, you mean? Not much! Come on and I'll show you."

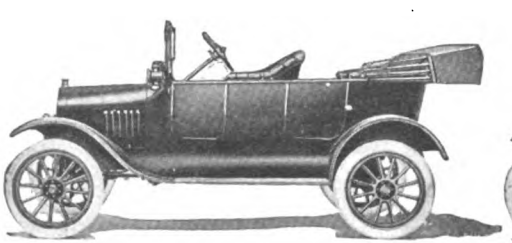
The two men go out to the garage and push out the Ford delivery wagon. In a few minutes it is changed into a neat five-seated passenger car which nobody would have suspected of being anything but that. Can so much be said for the grocer's horse that hauls the family surrey on a Sunday?

The combination device consists of a boxlike body with hinged sideboards which can be folded up flat and inserted beneath the floor of the ordinary Ford touring car. The tonneau is hinged to the front seat and to the rear wheel fenders so that it may be slid off toward the rear. The box body is then unfolded and set up in place of the tonneau to form a delivery wagon with a capacity of four or five hundred pounds.

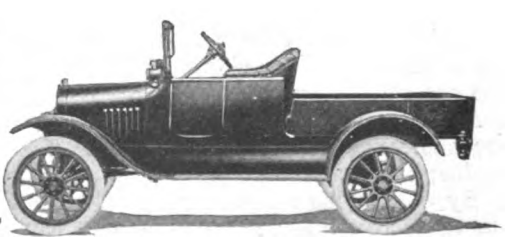
This car combines business with pleasure and fills a long-felt want.



Sliding off to the rear the tonneau which is hinged to front seat and rear wheel fenders



The wagon becomes a pleasure car. The delivery body is stowed beneath the floor



The car transformed into a regular delivery wagon, ready to carry goods up to 500 pounds

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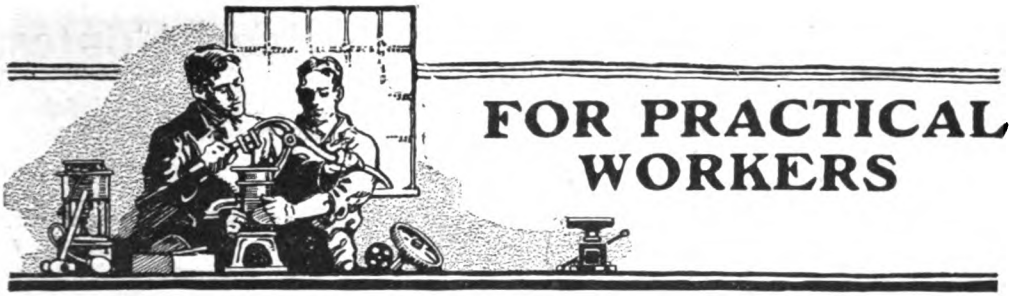
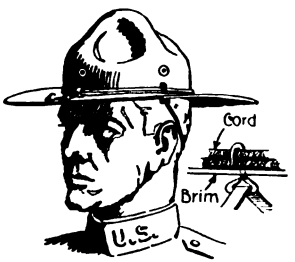


A Clip to Hold the Regulation Campaign Hat on the Head

THE regulation campaign hat must be kept on the head at all times during active service, and for this reason a chin strap is attached to each hat. This strap is not easily adjusted, so that the hat may be worn as an ordinary piece of headgear while the wearer is on a furlough or taking a trip to town. To remedy this one soldier attached clips made of blued steel, as shown, which hook over the cord bands and pass through the hat rim where the chin strap is attached. The illustration clearly shows how it is made and attached to the hat.—DUDLEY HESS.



A reliable cord clip for the soldier's chin strap

Using a Breast Drill to Coil Wire and for a Grinder

AS a mechanical expedient, in the absence of a lathe, an ordinary breast drill, secured horizontally to a table, and manually operated, may be employed as a highly useful substitute for a lathe; especially for such light work as winding springs or spool magnets, or for knife or tool sharpening and polishing operations, as well as for small turning jobs.

The preferred manner of securing the breast drill to the edge of a table is by a hand screw or clamp, which grips the bearing section of the breast drill frame to the table top (the clamp shown in the illustration is a ten-cent article, but is perfectly adequate for the purpose).

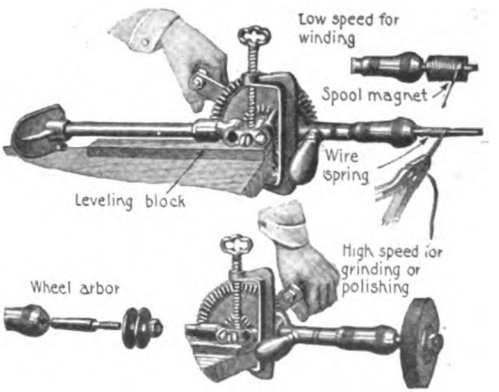
A thin block of soft wood, which is interposed between the underside of the drill frame and the table-top, serves to level the breast drill, and also acts as a protection to the table.

To wind wire springs, a mandrel formed from a large wire nail, or a piece of round rod, is gripped in the drill chuck, and the wire to be wound is then guided and held taut in the usual way with pliers by the spring maker, while the breast drill handle is turned by a helper. The same means can be employed in winding a magnet.

In most winding operations the slow speed gears of the breast drill should be used.

For knife sharpening, grinding, and polishing operations, the high-speed gears are best.

An inexpensive wheel arbor, suitable for securely holding emery or corundum grinding wheels, or buffing and brushing wheels, comprises a shouldered spindle, the reduced and threaded portion of which fits the center holes in the various wheels.



Positions of an ordinary breast drill for use in grinding or coil wire winding

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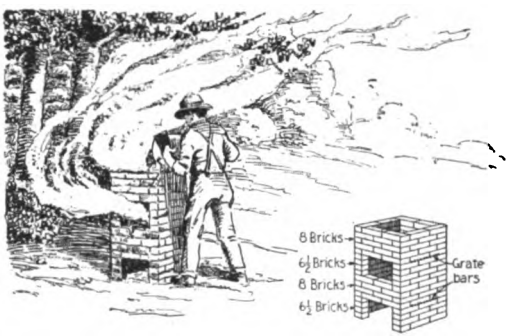
Helping Out the Farmer—Prize Contest

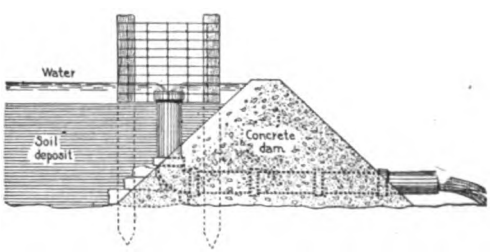
Tell the readers of the Popular Science Monthly about the simple, helpful devices you have invented for your own use, and try to win a cash prize

A GOOD farmer is a good mechanic. He has to be if he is to run a traction engine efficiently, chop wood by power, drain bottom land economically, and perform the thousand-and-one duties of the farmer with as little effort as possible. The difficulty of obtaining farm labor and the constantly widening use of machinery have made it more and more imperative to exercise ingenuity. We are convinced that the best inventive talent is to be found on the farm. Because it must express itself with the aid of simple tools and cheap material, we want to know more about it. We feel sure that among the thousands and thousands of farmers who have made farm-work easier for themselves, there must be many who have made simple machines or improved on old methods in ways that ought to be more thoroughly known.

The pictures on this page illustrate the type of subject that can be discussed in articles submitted in the P. S. M.'s "Helping Out the Farmer" contest. Study them and send in your ideas



Refuse and garbage are easily burned in this homemade incinerator built of bricks



To prevent the soil from being washed away in a low place this concrete dam was built

And so the POPULAR SCIENCE MONTHLY will conduct a Farmers' Labor-Saving Contest. Prizes ranging in amount from thirty-five dollars down are to be awarded in accordance with the rules given herewith. Some of the devices which will be described may be of sufficient commercial merit to justify their being patented.

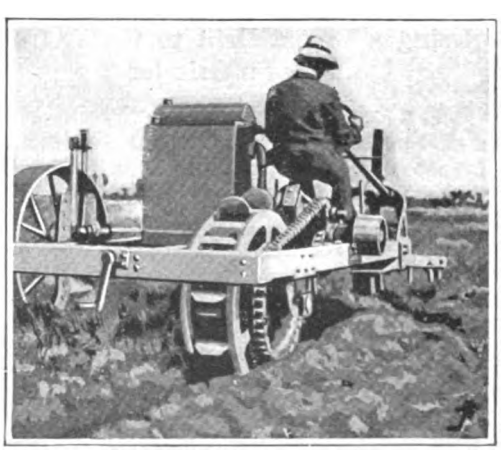
Rules Governing the Contest

(1) The device offered for consideration in this contest for practical farmers must be labor-saving in character. It must therefore be a machine or an arrangement of buildings, or a plan for a single building. A machine reduces muscular effort, and so can a well-worked-out plan.

(2) Architectural drawings of farm buildings, etc., which merely cheapen construction without enabling a farmer to reduce his muscular effort, are not eligible.

(3) The labor-saving device offered for consideration must be commercially new. In other words, it must not be purchasable in the open market.

(4) The device submitted must be of such character



A tractor having wheel lugs that automatically enter and leave the earth vertically

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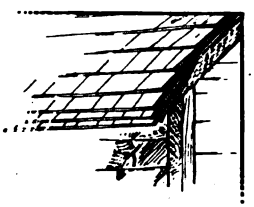
that it can easily be made by any farmer with the tools to be found on the average farm.

(5) Contestants are not limited in the number of devices which they may submit. But only one device can win the first prize, only one the second, etc. The contest is open to everybody.

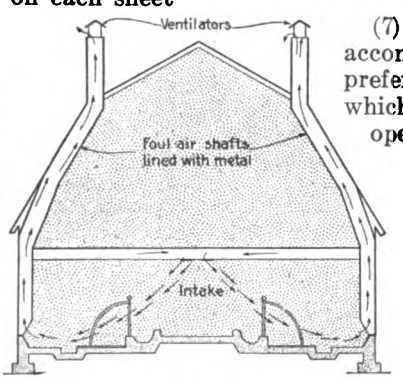
(6) The labor-saving device submitted must be clearly shown in one or more views. The drawings need not be made by a skilled draftsman. It is sufficient that they should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on bristol board. The views should be sufficient in number to set forth the construction and general arrangement of the parts clearly. The contestant's name and address should appear on each sheet of drawings.



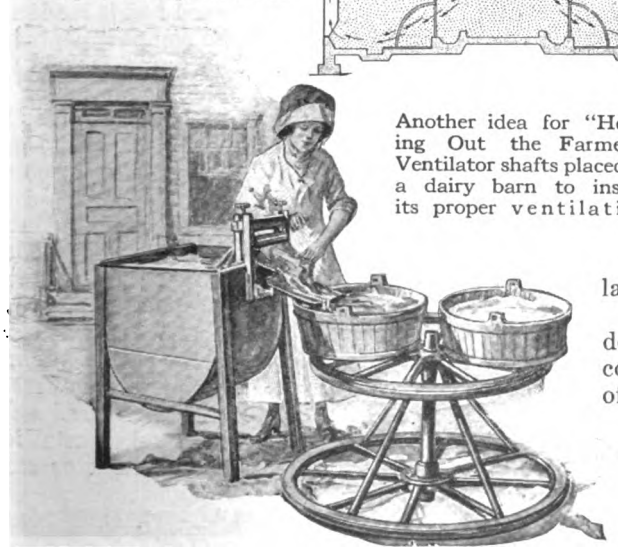
Bunching the shingles at the eaves so as to make an artistic effect

Here is a farm-labor saver of the kind that we want to consider in the "Helping Out the Farmer" contest. It's a concrete mixer made of parts of an old mowing machine and driven by the farm engine

Don't forget the farmer's wife in the "Helping Out the Farmer" contest. Wouldn't she like to use these two old cart or buggy wheels, as shown below, made into a revolving stand for the laundry? Perhaps you can think of something equally simple and practical



Another idea for "Helping Out the Farmer": Ventilator shafts placed in a dairy barn to insure its proper ventilation



(7) The drawings must be accompanied by a description, preferably typewritten, in which the construction and operation of the device are clearly given. It must be written on one side of the paper only, and it should not be more than five hundred words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.

(8) The drawings and descriptions entered by contestants must be received by the POPULAR SCIENCE MONTHLY not later than 5 P.M. on August 15, 1918.

(9) A first prize of thirty-five dollars will be awarded to the contestant who, in the opinion of the judges, (the Editors of the POPULAR SCIENCE MONTHLY), has produced the simplest and most desirable labor-saving device.

A second prize of twenty

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dollars will be paid to the contestant who submits a description of a device next in order of merit.

A third prize of ten dollars will be paid to the contestant who submits the next best, in order of merit.

(10) The Editor of the POPULAR SCIENCE MONTHLY shall have the right to publish meritorious devices which do not win a prize. The regular space rates will be paid to the contestants who submitted the drawings and descriptions of devices thus selected.

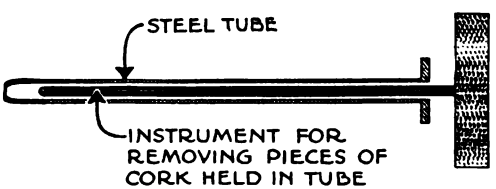
(11) Each contestant retains full property rights in the invention that he submits. The only restriction is that imposed by Rule 10.

(12) Contestants are requested to keep, for their own use, copies of their drawings and descriptions. The POPULAR SCIENCE MONTHLY cannot undertake to return material which has been entered but which does not win a prize, or is not accepted for publication in accordance with Rule 10.

(13) Address your drawings and specifications to the Farm Contest Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York, N. Y.

Making a Tool for Cutting Holes in Cork

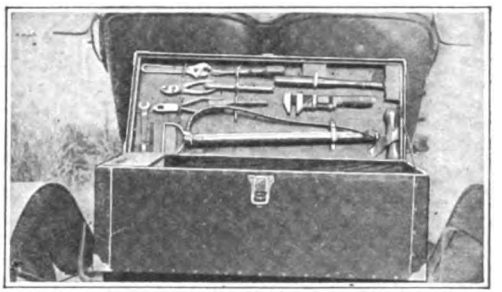
THE accompanying illustration shows a very satisfactory tool for boring into cork. It may be constructed easily from a steel tube of the right size, sharpened at one end. The cutting end may be sharpened frequently by rubbing it on an emery board, made by fastening a



piece of emery cloth to a suitable block of wood. The tool should be pressed into the cork with a rotary motion of the hand. The part of the cork that has been cut can be forced out with a blunt instrument, as shown. It must have a smaller diameter than that of the tool center. Every hole that is made in a cork should be smoothed out with a rat-tail file.

Combined Tool Case and Trunk for the Automobile

A VERY serviceable combination case and trunk for the automobile can be made of veneer boards covered with light sheet steel. In size it can be adapted to any automobile, but the one shown is 1 ft.



Tool case and trunk on the rear of an automobile, showing arrangement of the tools

wide, 1 ft. deep and 30 in. long. The corners are finished with regular trunk hardware and the whole is painted to match the color of the automobile. The inside of the cover is arranged to hold the tools. These are held in place with ordinary spiral screen-door springs fastened down at proper intervals with sheet-iron straps, leaving loops through which the tools are inserted. The tension of the spring holds the tools firmly in place, but still they can be easily withdrawn for use. In the lower part of the trunk at the left are two compartments, each just large enough to hold a spare inner tube.

A small wood-bottomed box is made to fit snugly over the tube compartments to hold small parts. The pump is held in place by inserting the handle under a narrow sheet-iron strap while the foot is held by a spring-actuated pin that slips into a small hole drilled for the purpose. The hammer head is inserted into a sort of open-sided box made of sheet iron and the handle is slipped under a piece of clock spring. These arrangements have proved very satisfactory after several months' use. The whole trunk was constructed in a home shop with ordinary tools. A vise and two flat pieces of steel ½ in. by 2 in. by 18 in. were used as a brake for bending the steel sheets for covering the trunk. The trunk or case presents a very neat appearance on the rear of an automobile.—N. O. MOORE.

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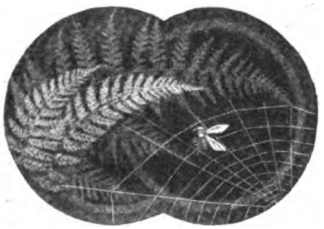
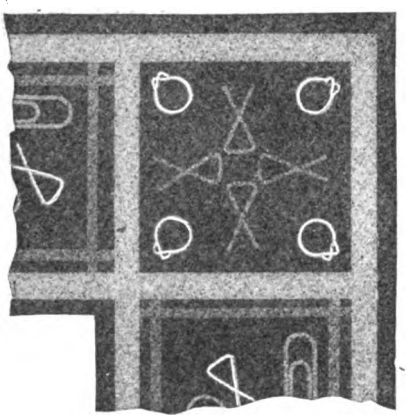
Making Decorations by the Spatter-Work Method

ALTHOUGH spotted work is by no means new, still few persons know what it is, and for what it can be used. Spotted work is an art that every person can quickly master. In fact it is extremely easy and demands no artistic ability.



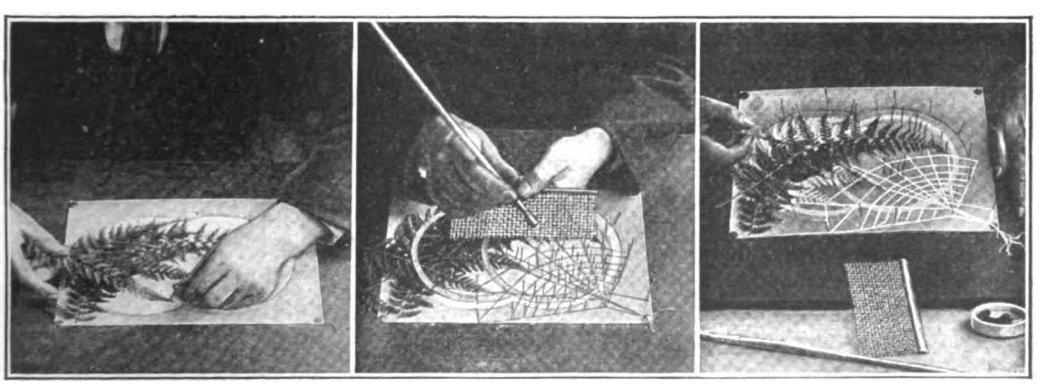
An attractive decoration made from fern leaves

Decorative work can be made on boxes as well as on paper. On boxes it is doubly effective when both the top and the sides are ornamented. When a dark-brown stain is used, the design on the box will resemble poker work. Small center pieces, table covers, and napkins may also be made if indelible inks are obtainable.



Paper clips can be used for making border decorations on a box or frame

Dried leaves are usually used, preferably ferns and other feathered leaves. To form artistic designs these are pinned flush with the paper, when paper is taken. To heighten the effect, a butterfly or a bee may be added. These must be cut accurately from paper and then pinned on. If a cobweb is added, the finished design will be very effective. In order to make the web, take numerous pins and a long, thin cord, stick the pins on the paper and place the cord tightly about them, until a general resemblance to a cobweb can be noticed. Now the paper is ready to receive the ink. The best results are obtained from a wire screen 3 in. wide and 6 in. long, having a mesh of about ¼ in. A short, stout brush similar to those used for stenciling must be procured. This is dipped in a not too fluid ink and gently brushed over the screen. The screen should not be held over 6 in. above the design. Small spots will soon appear over the entire surface of the paper. When sufficient ink has been used (that is when the ink has been evenly distributed over the paper), take off the topmost leaf, which will now be white throughout. Resume brushing. Take off another leaf and brush again. By this method, the leaf taken off first will be the darkest, while the one removed last will be lightest of all. Of course there will be many *gradations* between these two, making a pleasing contrast. If a bee, butterfly or cobweb were added to the design, it should be removed when the sprinkling is half finished so as to be partly covered when the design is completed.



Different stages in placing the leaves, spattering the work with the use of a screen and laying on card for the design of a cobweb to form an effective combination with the leaves

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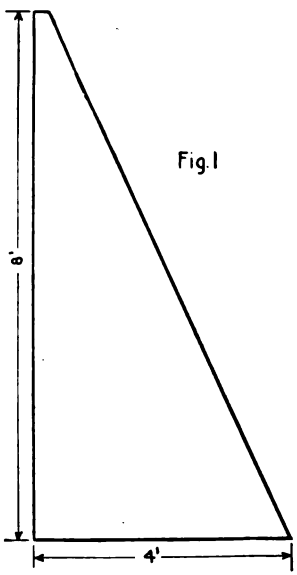
Open Canoe Cruising

IV.—A canoe-cruising outfit for the one-night and permanent stand. Choice of tents, cooking equipment, clothing, food, tableware and beds

By E. T. Keyser

CANOE-CRUISING outfits fall into two classes, the light, compact equipment for the week-end encampment or the extended cruise where one-night stands are the rule and where every bit of duffle must be unpacked and arranged at the close of each day's journey, and the more comfortable and elaborate layout of the permanent vocation camp from which the canoeist makes short day trips.



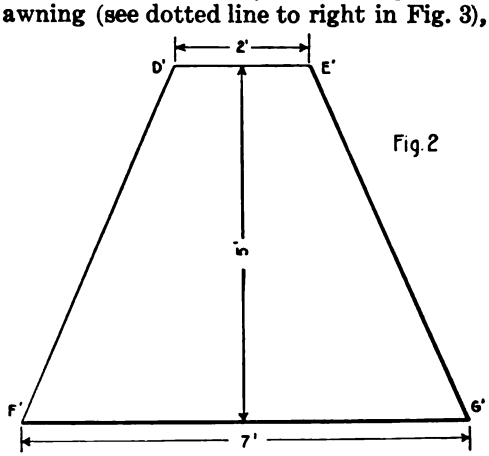
Pattern for one-half of each of the four sides

When going light and pitching the tent every day or two, the waterproof pyramid tent with a projecting awning door is the best type to carry. Such a tent, 7 by 7 ft. on the ground and 7 ft. high, will accommodate two persons comfortably and may be easily and cheaply built by the canoeist. In Fig. 1 is shown a pattern of one-half of each of the four sides. It would be a right-angled triangle of 8 ft. altitude and 4 ft. base, but for the fact that the upper angle is clipped, leaving 2 in. between the side and hypothenuse.

Cut eight of these sections from unbleached muslin and join them in pairs along the sides, overlapping with a 2-in. seam. Then join the sections so made to each other along the hypothenuse of each, lapping 2 in. Before joining the last two sections, lay the tent out flat and paint it with gasoline into which has been shaved as much paraffin as the gasoline will dissolve. Paint both sides of the material and then hang it up to dry. When the gasoline has evaporated, the paraffin fills the pores of the muslin and it is made waterproof.

Turn up a 2-in. hem around bottom of tent and sew up the remaining open side. Then sew all around the bottom edge the sides of a heavy brown canvas floor cloth. Then cut out and sew together the awning door as in Fig. 2. This is 2 ft. wide across top, 7 ft. wide at bottom, and 5 ft. high. Lay the tent on the ground and peg it out and stretch one of the sides taut and fair. Then mark out the position of the door *A*, *B*, *C* (Fig. 3). This door, shown by the broken lines, is 5 ft. high, of triangular form with a 4-ft. 6-in. base which is 6 in. above floor of tent. This leaves a sill to keep out rain and insects.

Sew door as in Fig. 2 to the tent, letting *D'* coincide with *D*, *E'* with *E*, *F'* with *F* and *G'* with *G*. This is to be heavily sewed from *D* to *E* and fastened from *D* to *F* and from *E* to *G* by small snap hooks or tapes as desired. This door will be found very convenient. It may be rolled up and held in place with tapes placed at *D* and *E* or, by setting loops at *B* and *C*, may be held up as an awning (see dotted line to right in Fig. 3), allowing tent door to remain open during a sultry shower and shading the interior of the tent on a sunny day.



Design pattern for the door of the tent which is used also for a shade

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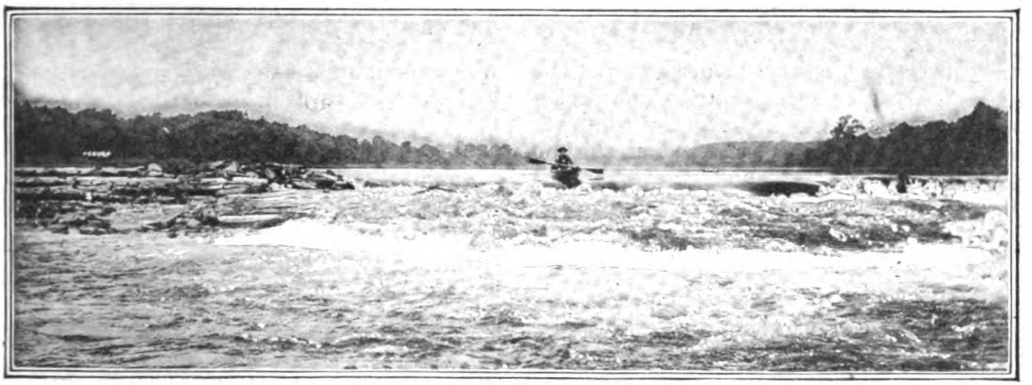
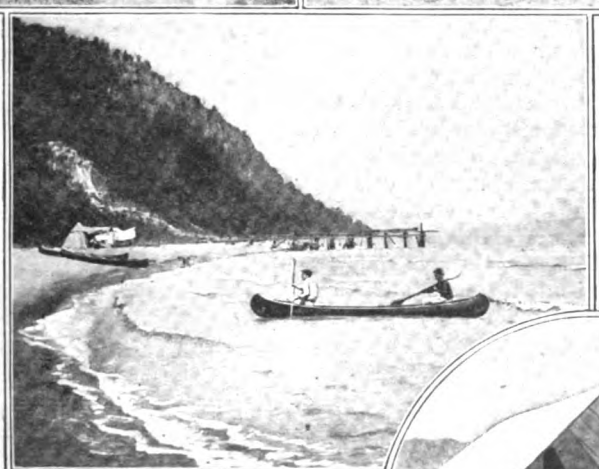


The canoe in fresh water: Shooting the rapids of the Delaware River, where the canoeist must keep his wits about him and watch out for submerged rocks and treacherous waves

An ideal outfit for the one-night stand: A pyramid tent, a folding chair, and a collapsible table

The permanent camp. A 7 x 7 wall tent with projecting fly, under which the table is set



Canoeists making for the beach of a Hudson River encampment. A complete equipment for two is stowed below the gunwales

A boy of thirteen can carry the pyramid tent and the clothing bag without the least difficulty

The projecting fly of the wall tent keeps off sun and rain and makes the coolest place in camp

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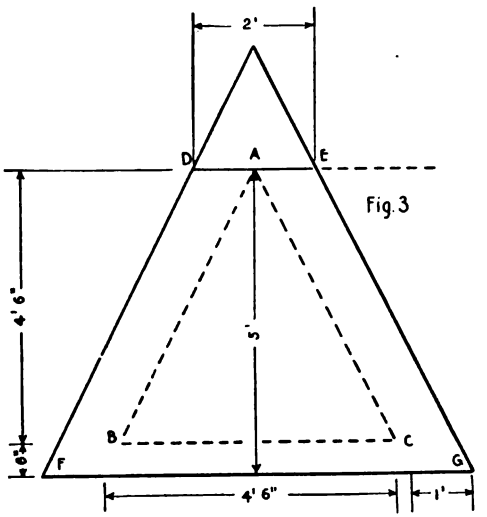
A single pole, 7 ft. long and ferrule-jointed at the center, supports the tent, a ¼-in. brass pin is set into the end of the pole and passes through a wooden bull's-eye sewed into the apex of the tent. A rope with a knot in the lower end may be passed through the bull's-eye and used to suspend the tent from the limb of a



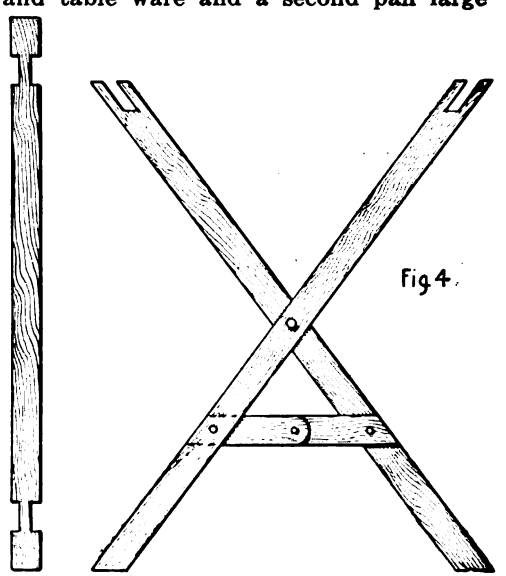
Front view of a pyramid tent, the dotted lines showing the opening cut for the doorway

tree or from a pair of poles cut at the camp site and arranged shear fashion. The tent described will weigh but 16 lb. and when packed makes a roll 20 in. long by 10 in. diameter, which may be handled easily by a small boy. It requires but four pegs, one at each corner, placed through a loop of ¼-in. clothes line sewed to each corner of the floor cloth.

For a permanent camp, there is nothing better than the regulation wall tent with a projecting fly. Such a tent, 7 ft. long, 7 ft. wide and 7 ft. high at ridge and 3 ft. at eaves, will accommodate two persons comfortably and four at a pinch. With a floor of heavy waterproof brown canvas and a 14 by 14 ft. fly it will weigh 32 lb.

An 8-oz. non-waterproof canvas is heavy enough for the tent as the fly keeps off the rain and heavy drill is correct for the fly which projects 7 ft. in front of the tent, forming an open-air kitchen and dining-room. The three poles should be ferrule-jointed and the ridge pole hinged so that all may pack in a 3½-ft. length. A rope ridge or a stake cut at the camp will serve for the fly. A few wire screw hooks, such as are made for clothes closets, set into ridge pole and end poles, will accommodate the campers' wardrobe and may be removed when taking down the tent.

The choice of camp stoves depends upon local conditions. Where drift wood is plentiful a wire refrigerator shelf laid across two logs or topping a three-sided stone fire-place allows one to obtain the maximum service from a wood fire, but where wood is scarce, a kerosene-vapor stove or even a pocket alcohol cooker will prove the better arrangement and the latter may be utilized inside the tent in rainy weather. The minimum for comfort in a cooking outfit consists of a frying-pan, coffee percolater, folding-handle saucepan with cover, and a pail for boiling water; they should all be of enamel or aluminum ware which may be left outside over night without danger of rusting. Cut off the handle from frying-pan, using a cheap little monkey wrench for a removable handle. Each person will require two plates, one cup, one soup bowl, a knife, fork and two spoons. After collecting the equipment, purchase a tin pail large enough to contain both kitchen and table ware and a second pail large



Trestles and cross bars for making a camp table that is compact when folded

enough to hold the first. If the bail of the inside pail is without a wood handle and the top has a folding ring instead of a knob, one can get a closer telescopic fit.

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The larger pail is simply a carrying case to prevent soot from the inside pail from soiling the outfit.

In Fig. 4 is shown the lightest and most compact type of camp table. It consists of two wood trestles, pivoted by a bolt or rivet. The upper ends of each are slotted as shown and the lower ends held rigid when open by jointed folding brass braces. The trestles are joined by two strips of wood, notched to fit the slots in trestle heads, and across these is laid a table top of two thicknesses of enameled duck sewed together with pockets between, in the same manner as the canoe cushions already described but with thin wood slats or lath inserted. The dimensions depend entirely upon whether the canoeist expects to sit upon a camp chair or a cushion when eating. The four wooden sections fold together and may be wrapped within the rolling top making a light compact bundle; the advantage of the enameled duck surface lies in its inability to absorb grease.

Camp beds are of three types—air beds, cushions and folding cots. The first is the most comfortable, but against this advantage is the drawback of weight and bulk and it must be inflated when making camp and deflated for packing. It is therefore less suitable for the light-weight outfit of the one-night camp than a less comfortable but more compact cushion bed constructed after the manner of the canoe cushions already mentioned. The folding camp cot, while rather weighty, is compact and comfortable. It cuts down tent accommodation less than a cushion bed as it permits of storage space beneath it being utilized. To counterbalance this advantage, it requires as much bedding beneath as above the sleeper and cannot be utilized to advantage in a small tent such as the pyramid already described. For a wall tent, if topped off with an air bed, it is ideal.

Two pairs of all-wool 4-lb. blankets per camper constitute a better outfit than one pair of heavier covering, as they permit of several combinations of warmth according to the conditions which may prevail. They should be either red or dark gray in color.

A soft, light-colored felt hat with a wide brim, a gray flannel shirt, light or heavy weight according to season, khaki knickerbockers with long stockings, over sleeveless undershirt and knee-length drawers, constitute a practical and comfortable dress. Soft-soled, low-cut moccasins for the canoe and a pair with stiff leather soles for ashore, a sweater coat with sleeves, and an oilskin, long cut, will complete the outfit. At least one change of shirt, knickers, hose and underwear is necessary in case of becoming soaked with rain or perspiration. These articles and the toilet outfit can be carried in a waterproof canvas duffle bag, 30 in. long and 10 in. diameter. The bag should have one handle on the side for carrying and another on the closed end so that its contents may be shaken out when wanted.

Sugar, salt, butter, lard and coffee are best carried in screw-capped preserve jars with mouths wide enough to allow the hand being inserted for cleaning. Flour, Indian meal, tea, cocoa, baking powder, washing powder, rice, etc., should be carried in air-tight tins, such as some tobaccos come in. Home-made muslin bags with draw-string tops are convenient containers for potatoes and bread, and all these individual containers are in turn to be carried either in tin cracker boxes or large tin pails. The kerosene stove is carried in a small pail of its own which has also accommodations for a bottle of alcohol for priming and for a couple of quart tin canteens for kerosene. The water is best carried in a canvas water-bottle which occupies no space when empty and which when full does not threaten the planking of the canoe in rough weather. If the type with an attached funnel cannot be obtained, be sure to carry a tin funnel along for filling the jug; it will save much time and trouble.

It will be observed that every article has been provided with a waterproof container or covering. The blankets with the air bed or cushion are laid upon the floor of the tent before the latter is struck. Then the tent is folded with the waterproof flooring outside and the whole made up into a waterproof roll which is strapped or securely roped. The tent may be pitched in a pouring rain and the bedding remain dry and one may start out on a cruise in a downpour and arrive in camp with everything dry—a change of clothing, a rub-down for the skipper and

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crew, and every one is ready for the evening meal despite weather conditions.

Keeping a camp sanitary is the easiest thing in the world if every bit of refuse is buried immediately or burned in the fire before the flies congregate. As most of the insects which infest the average tent are attracted by lighting the canvas abode at night, this should never be permitted except when absolutely necessary; the tent, moreover, is usually much lighter at night than one would suppose possible. A mosquito netting pinned around the entrance will do much to keep out flies and mosquitoes. At the same time a lantern should always be included in the outfit. It may not be needed once in a dozen trips but when it is wanted it will be needed badly. I have been all down the line with electric, carbide and folding candle lanterns and have wound up just where I started, with the old-fashioned tubular lantern. It is bulky, smelly and smoky, but it is there when needed, which is something which cannot always be said of batteries and carbide under camping conditions. Of course, for trips far afield where kerosene cannot be obtained, the folding candle lantern is the only logical equipment.

Much of the outfit described in this series may be made by the canoeist himself or purchased reasonably and it is light and simple enough to furnish a splendid summer for the youngest cruiser, while at the same time it represents the process of many seasons of experience.

The End

A Simple Way to Distinguish Iron from Steel

THE repairer of machinery often has to select pieces of metal from the scrap heap to make repairs on various machines, and is at a loss to know whether the metal he has selected is iron or steel. By using the following methods, wrought iron, cast iron and mild steel are easily distinguished from each other. File a bright spot on the metal and place a drop of nitric acid on the metal and leave for a few minutes.

The spot will appear ash-gray on wrought iron, brownish-black on mild steel, and a deep black on cast iron.

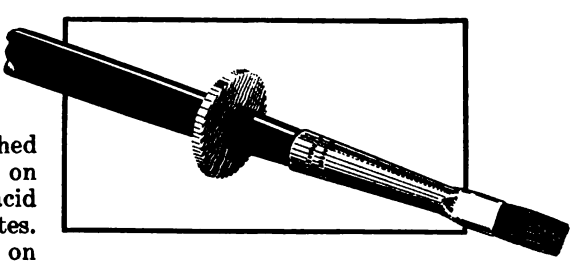
Easy Removal of Exhaust Valves from Motorcycle Engines

GREAT difficulty is often encountered in removing exhaust valves, on account of the spring. To extricate them a piece of U-shaped steel may be used with considerable ease. Turn over the engine crank until the valve is wide open, then insert the piece of steel between the tappet guide and the washer on which the spring rests. The metal piece should be long enough to exactly fit this space when the valve is fully open. Turn the engine until the cam permits the valve to close. Then the metal piece will support the spring washer. Put a screw driver in the slot in the top of the valve head, and tap it lightly until the washer is loose from the valve stem and the valve will drop to its seat. The spring is held clear of the lower end of the stem by the metal piece. It is then an easy matter to unfasten the valve stem cap and to remove the valve. —NORMAN WUNDERLICH.

A V-shaped piece to hold the spring washer

A Brush Shield Made of a Rubber Washer

A SMALL rubber washer slipped on the handle of a small brush, as shown in the illustration, will prevent any paint from running down the brush handle and will also keep it from smearing any surface on which it may be placed when not in use. Such a washer can be cut from a piece of rubber tire that has been discarded.—JAMES M. KANE.



A washer cut from a piece of rubber tire placed on the handle of a small brush

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Ornamental Fern Basket Made in Lattice Work

THIS basket is one of the prettiest fern holders made for the lawn or flower garden. It consists of a box which is smaller at the bottom than at the top and has strips nailed on it as shown. Two of the strips are bent for the handle and a number of short pieces nailed on it crosswise. The strips, which are $^3/_{16}$ in. thick and 1 in. wide, are nailed on the sides of the basket the same as lattice work.

Pedestal flower box representing a basket

The box used as a base is large enough to hold a tin pail or a flower pot which in turn holds the earth for the growing plant. When the stems and leaves grow all over the top of the basket and covers it well it produces the appearance of a large basket of flowers. If it is well painted it will stand any kind of weather. The pedestal consists of four pieces of lumber nailed together in box form. However, it is not necessary to have a pedestal as the basket can be set on the porch or the stump of a convenient old tree.—CHARLES SCHADEL.

Perforating Paper Sheets with Sharpened Cog Points

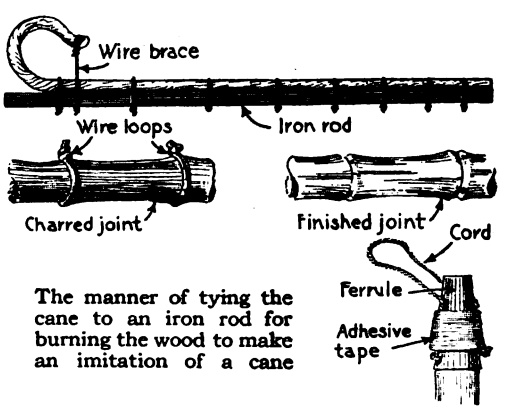
ONE day in the office I needed to perforate a sheet of paper, and as I had no special device for the purpose, I looked for a way out of my difficulty. By taking an old common clock cog wheel, which was in the bric-à-brac on the desk, sharpening the points of the cogs a little with a file, and then inserting a pencil through the cog wheel and rolling it over the paper, the sheet was perfectly perforated.

As a matter of fact the device works so well and has proved so valuable and labor-saving to me that I am going to keep it for permanent use in my office.—H. K. CAPPS.

Finishing a Rough Stick To Imitate Burnt Bamboo

TO prevent a rough stick from warping it was wired to a square iron bar and run through a gas flame to give it a burnt finish. Upon removing the stick from the rod, the surfaces under the wire loops were found to be little fire-worn and as they were higher than the burnt surfaces they suggested the joint divisions of a bamboo rod and the stick was finished for one.

If the stick is perfectly seasoned it should not warp in the flame. If at all green it should be wired to some material that will not bend. Use as many heavy wire loops as desired for joints in the stick. A curved handle will need a wire bridle to prevent the curve from uncurling. Use a torch or gas flame to do the burning, allowing the flame to dwell longer on the portions requiring depth of color. If the stick is fastened to a rod, it will be necessary to remove it to finish the side that rests against the rod. Remove charred surfaces, model for form and draw the color with sandpaper, glass or a file, then smooth with fine sandpaper. Rub in a little oil and rub clean, then apply several coats of pale shellac. Rub down each coat with sandpaper and the last coat with oil and shellac for a dull finish. If



The manner of tying the cane to an iron rod for burning the wood to make an imitation of a cane

a high polish is desired use varnish. To hang up the stick without smudging the surface, knot a string and fasten it on the ferrule with adhesive tape as shown. The finishing of a stick in this way permits of so much originality both as to color and shape as to render the completed cane well worth while.—JAMES M. KANE.

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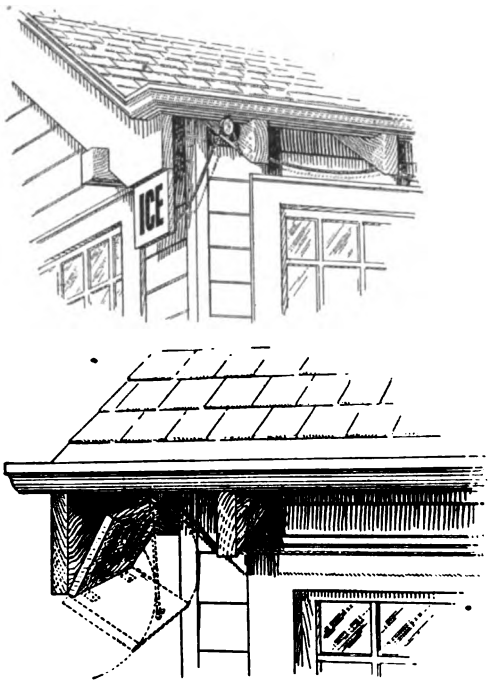
Novel Arrangement for an Iceman's Sign

IT IS the custom in some cities for the local ice companies to furnish their patrons with pasteboard placards to be



An ice sign hinged to the edge of a verge board which is worked by a cord

displayed in a conspicuous place on or near the house, where it may be seen from the street, on those days when a supply of ice is required for the refrigerator. Obviously this is to save time for the iceman and to spare him the inconvenience of stopping when he is not needed. Aside from the shock to one's esthetic taste of having the front of your residence decorated with such a sign, there is always the possibility of its being misplaced or blown away, which means extra steps to post it and return it again to its place of safe-keeping.

An ingenious friend of mine has devised a simple means of overcoming some of these little difficulties. To the lower edge of the verge-board which overhangs the front corner of his house he has hinged a ½-in. board, to the front face of which he has securely tacked the paper sign. At the bottom of the board in the center is attached a strong cord which runs up through a small pulley above and back along the rafters under the eaves until it reaches a point within the screen-porch directly alongside the refrigerator. When no ice is desired, the sign is drawn up behind the verge-board and completely hidden from view. Of course the verge is not the only place where the sign may be attached. A beam conveniently situated, a gutter, or even the limb of a tree might serve equally as well.—HUNTINGTON BAKER.

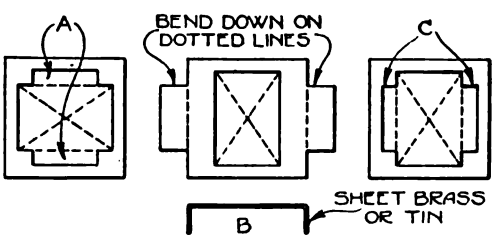
A Method of Loosening Tight Nuts or Bolts

IF the nut or bolt is rusted so tightly that no amount of manual energy will loosen it, then chloroform it. A few drops of this drug, placed on the nut or bolt, so that it can soak into the threads, will loosen them so that the nut may be turned quite easily. Kerosene, used in a similar manner, will give the same results, but requires much more time to cut the rust.—PETER J. M. CLUTE.

Masking Device for a View Finder on a Camera

AMATEUR photographers, taking a picture, when locating the person to be taken in the view finder, often include the view in the space *A*, and when the negative is developed find that part of the picture is missing. The photographer has forgotten that only the view indicated within the dotted lines will show in the picture.

The masking device shown in *B* can be clamped over the view finder, thereby blocking out the not-wanted space *A*.



A view finder mask to be clamped over the unused open spaces on the cross screen

When taking vertical pictures, the masking device may be clamped so as to block out the view *C*.—FRANK HARAZIM.

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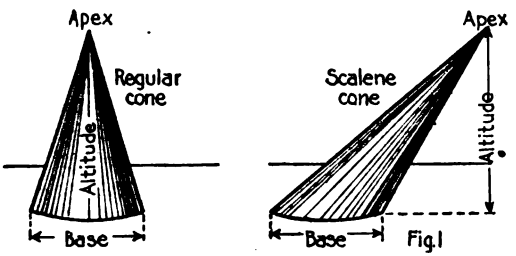
Simple Designs for Sheet Metal Working

XIV.—Radial line development of patterns for pipe fittings that are parts of scalene cones

By Arthur F. Payne

Director of Vocational Education, Johnstown, Pa.

THE problem presented in this issue will be the last in which "radial lines" are used as a means of developing the patterns. In the March, 1918, issue radial lines were used for the first time in this series. All of the other "radial line" developments have been parts of "regular cones," that is, cones in which all of the sides are equal, as shown in Fig. 1. The problems in this issue are parts of scalene cones, that is, cones in which the sides are not equal.

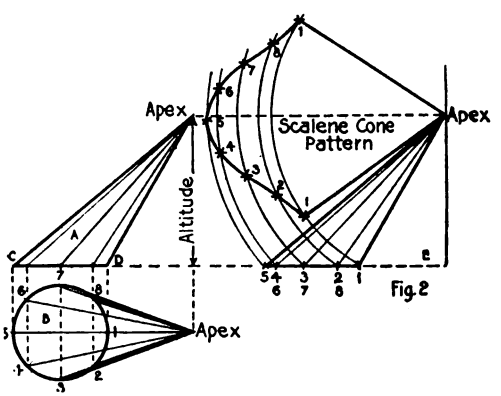


A regular cone with all sides equal and a scalene cone without equal sides

There are two distinct methods of developing the patterns for scalene cones, the simplest is by the use of radial lines, the other is by "triangulation." The triangulation method will be started in the next issue.

In Fig. 2 is shown the method of developing a pattern for a scalene cone by means of radial lines. First, draw the front view *A* of the cone (note where the altitude is measured in Fig. 1); second, draw the bottom *B* as shown; third, divide the bottom-view circle into eight equal parts and draw lines from these points to the apex. The pattern would be more accurate if the circle were divided into twelve or sixteen parts, but to avoid making the drawing complex only eight have been used in the illustration. Looking at the front view *A* it will be seen that the lines *C*-apex and *D*-apex are the only lines that show their true length. This is the case in all cones. It will be remembered that in recent problems the true length of the other lines was obtained by projecting them over to the side lines. In scalene cones a different method is used which is as follows: Fourth, draw the right angle *E*, then with the dividers measure the distance 1-apex on the bottom view and set off as a distance 1-*E* of the right angle *E*. In this manner measure all the other bottom-view distances, 2-apex, 3-apex, 4-apex, etc., and set off from the right angle *E* as shown. The purpose of this is to get the true lengths of these lines. It really is elementary triangulation, and is explained as follows: If two sides of a triangle are given it is very easy to get the length of the third side. In this case we have the length of one side *E*-apex obtained from the front view *A*. We next get the length of another side from the bottom view *B*. Fifth, we now draw lines from the points on the line *E* to the apex; these lines are the true lengths of the foreshortened lines in the front and the bottom views.

Do not be discouraged if you do not understand the foregoing explanation,



A method of developing a pattern for a scalene cone by means of radial lines

as this problem of triangulation will be thoroughly explained in the next issue. Sixth, now we can lay out our pattern. With the apex as the center, strake arcs from each of the numbered points on the

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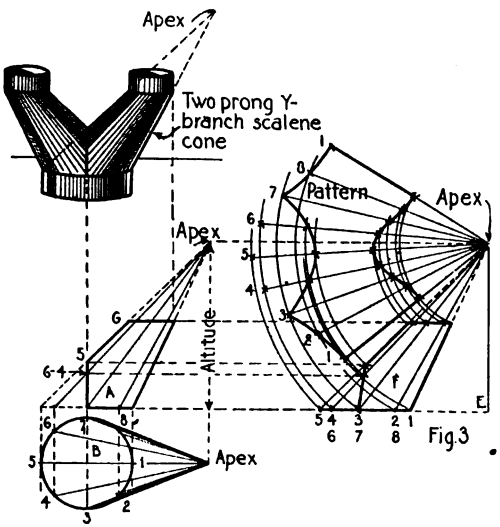
base line *E*-5. Seventh, anywhere on the arc coming from point 1 make a cross, set the dividers at the distance from point 1-2 on the bottom-view circle, set this distance off on the arc 2 and make a cross at this point. Set the same distance off from point 2 to the arc 3, and so on



A two-pronged branch consists of parts of two scalene cones made from one pattern

until you have set off the eight spaces. Connect all the crosses with a curved line and draw a straight line from both point 1 to the apex and the pattern for the scalene cone will be complete.

A practical application of the methods just described is shown in Fig. 3. The problem is to develop the pattern for a "two-pronged Y-branch." The first thing necessary is to recognize that it is part of a scalene cone, as illustrated by the dotted line in the sketch of the completed branch. Both sides of the branch are alike so that it is only necessary to make one pattern. The steps taken are exactly the same as for Fig. 2.

To develop the pattern, first, draw a front view *A* and bottom view *B*. Second, divide the bottom view circle into eight equal parts and draw lines to both apexes. Third, draw the right angle *E*, making the height equal to the altitude of the cone. Fourth, set off the distance *E*-1 equal to the distance apex-1 of the bottom view, do the same with the other distances. Fifth, now we have to locate on our true length, view *F*, the joint line where the two pieces of the branch come together at the center. This is done by projecting lines across from the front view *A* to the true length view *F*. The lines projected begin at the points where the center joint line crosses the lines 5 and 6-4, going to the apex. They end on the same lines on view *F*. Make crosses, then connect these crosses with a straight line. Sixth, project the top line *G* from the front view *A* to the true length view *F*, as shown in the drawing. Seventh, now we are ready to lay off the pattern. This is done by drawing arcs with the apex as the center from the numbered points at the base of the view *F*. Eighth, set the dividers to the distance 1-2 on the bottom view, and starting anywhere on the arc 1 set this distance from arc 1 to arc 2, etc., exactly the same as for the one in Fig. 2. In this problem it will be necessary to draw the radial lines from the points on the arcs to the apex, because we now have to locate the curve for the center joint line and for the top line of the pattern. Ninth, to locate the three points, 4, 5 and 6 for the center joint line, draw two arcs from the crosses on the center joint line of view *F*. When these arcs cross the radial lines 4-5-6 make crosses and connect them with a curve at the bottom line and the pattern is complete. Tenth, now we have to locate the points for the top line of the pattern. This is done by drawing arcs from the crosses on the top line of View *F*. Where the arcs cross the same numbered radial lines make crosses, connect the crosses with a curve and the pattern for the "two-pronged Y-branch" is complete.

In the illustration Fig. 4 is shown a more complex problem, the development of patterns for the "three-pronged branch." This problem has one new element in it; that of location of the joint line, otherwise the process of development is exactly the same as in the other problems in this issue.

The first step is to draw the bottom view *A*. Be sure and draw this view in the position as shown. This is necessary because we must have the right prong of the front view in its true elevation. The two prongs on the left (only one can be seen, the other being just back of it) are "foreshortened," that is, the top of the prong seen is slanting toward the ob-

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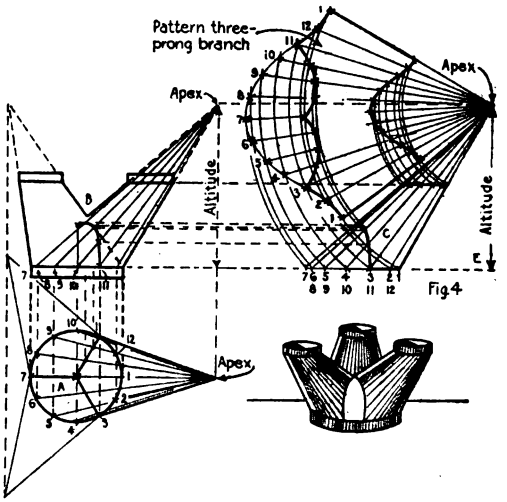
server, the one on the back is slanting away. The pattern could just as well be developed without the prongs on the left being shown, but it was thought that they would make the problem more easily understood.

The new element in this problem is the location of the joint line. This is done after the bottom view *A* and the front view *B* have been drawn by following the steps as described for the previous problem. To locate the joint line on the front view, mark with a cross the points where the joint line on the bottom view crosses the radial lines 7-8-9-10-11 going to the apex. Project lines from these points up to the front view to where they cross the same numbered radial lines going to the apex. At these points make crosses and connect them with a curved line. Note that this joint line on the front view is foreshortened, that is, point 11 is the nearest and point 7 is farthest away.

Now draw the true length view *C* as described for the previous problem. Briefly the steps taken in order are: Project the altitude over to the left from the front view. Draw the right angle *E*. Take the distance apex-1 on the bottom view and set it off as *E*-1 from the corner of the right angle. Take the distances apex-2, apex-3, apex-4, etc., and set off as *E*-2, *E*-3, *E*-4, etc., on the right angle. Draw radial lines to the apex from the points on the view *C*.

From the front view *B* joint line points, project lines across to the view *C* until they cross the like numbered radial lines. Make crosses at these points and connect them with a curve and we are ready to lay out the pattern. Lay out the bottom part first. With one point of the compasses at the apex swing the arcs from the numbered points at the base of the cone as in view *C*. Then set the compasses at the distance 1-2 on the bottom-view circle and starting anywhere on arc 1 set off this distance over on arc 2, then to arc 3, etc. From these points draw the radial lines to the apex. Now swing the arcs over from the joint line points on the view *C* and where they cross the like numbered radial lines going to the apex make a cross and connect them with a curved line at the bottom line and the pattern is developed.

Project the top line of the prong from the front view *B*. From the points where the top line crosses the radial lines swing arcs over until they cross the same numbered radial lines and make crosses at these points and connect them with a curved line and the pattern for the "three-pronged branch" is complete.



The development of a pattern for a more complex problem for a three-pronged branch

One of the numerous questions sent in by readers of this series is "how can I find the diameter of the prongs of a Y-branch when the area of all the prongs must be equal to the area of the large outlet?" The answer to this question is best given by two rules governing the circle. The first rule is to multiply the square of the diameter by .7854 and the product is the area. An illustration of the working of this rule is: we have a large outlet, the diameter of which is 9¾ in. This expressed as a decimal is 9.75 in. Square this (multiply it by itself) and we have 95.0625. Multiply this by .7854 and we get 74.662, area in square inches. Now if we have three prongs we divide this area by three which gives us 24.887. The second rule is to multiply the square root of the area by 1.12837, the product being the diameter. This will give the diameter of the three small prong outlets as follows: The square root of the area, 24.887, is 4.91215. Multiply this number by 1.12837 which gives 5.5427226955, but only use 5.54 which is accurate enough. This is about 5 $^{9}/_{16}$ in. in diameter for the small prong outlets,

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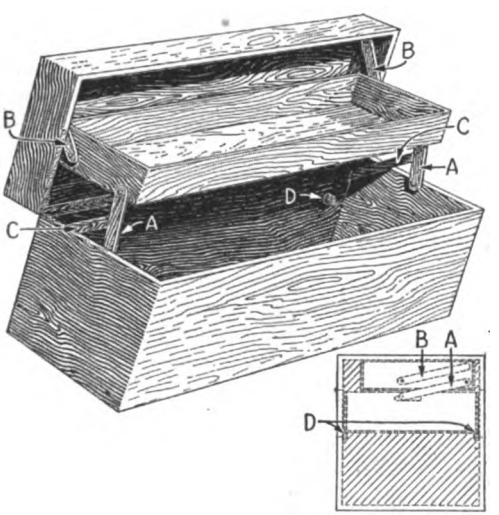
the sum of the areas of which will be equal to the area of the large outlet, the diameter of which has been given as 9¾ in.

This illustration of the application of the science of mathematics to the art of sheet-metal working is only one of many opportunities that are open to the trade workers to apply the science of their trade in their daily work. The principles of chemistry, physics and mathematics are the bases of "trade science," and to the ambitious worker who has by practice acquired the art of manipulating the tools of his trade the field of trade or applied science affords a wonderfully interesting opportunity for growth that will repay the worker richly in terms of pleasure, self-development and money.

Making a Shirt-Waist Box with Inclosed Tray

MATERIAL for the box and cover should not be less than ⅝ in. thick. The tray, levers and stops are made of stock not over ⅜ in. thick. Poplar is a very good wood for this box; but any



An inclosed tray with levers to lift it when the box cover is thrown back

soft wood may be used with good results. The inside measurement of the box is 40 in. long, 18 in. wide and 16 in. deep, and the cover is the same length and width and 5 in. deep.

The outside measurements of the upper tray is 39¼ in. long, 15 in. wide and 4½ in. deep, and the lower tray is 38 in. long, 17¾ in. wide and 6 in. deep. The levers *A* and *B* are each 9½ in. long, 1½ in. wide and ⅜ in. thick. The holes for screws are 8 in. apart from center to center. To prevent the cover from dropping too far back, bumpers *C* are provided at the ends. These pieces are each 6 in. long, 1½ in. wide and ⅜ in. thick. The lower tray rests on four knobs *H*, each 1 in. in diameter and ¾ in. long placed in the corners of the box at the right level.

The lever *A* is attached to the front corner of the tray ⅝ in. from the bottom and 1⅛ in. from the front. The arm *B* is attached to the end of the cover 1⅛ in. from the front and 3 in. from the bottom edge, and the opposite end is attached to the upper tray 1⅞ in. from the bottom and 8¾ in. from the front corner.

The piece *C* is attached to the box end on the inside so that its square end comes against the piece *A* when the cover is raised to the proper height required for its use.—GEORGE F. PETERS.

Chemical Action That Apparently Changes Wine Into Water

MAKE a deep purple solution of permanganate of potash in cylinder *A* by placing in the bottom one or two small crystals of the substance and filling with water. Fill cylinder *B* with colorless sulphur dioxide gas from generator *C*. Pass the gas through a perforated cardboard at the top of the cylinder and being heavy it will settle and displace the air. When the cylinder is full remove the cardboard and delivery tube and cover with a glass plate. The sulphur dioxide is generated, as shown in the diagram, by pouring diluted muriatic acid onto sodium sulphite powder.

Having prepared the two cylinders in advance of the demonstration remove the generator from sight and at the psychological moment pour the purple permanganate solution into the apparently empty cylinder of sulphur dioxide. As the purple liquid enters the cylinder it is immediately decolorized and seems to change to "water." The sulphur dioxide removes oxygen from the permanganate and changes it to a colorless compound.

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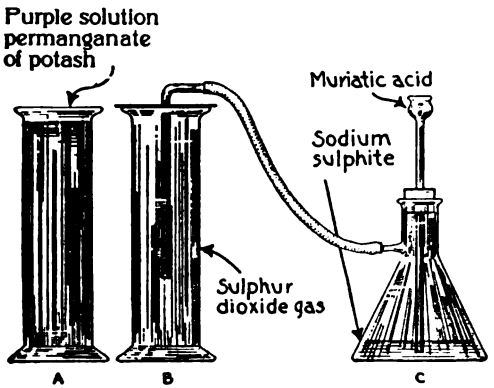
The sulphur dioxide gas may also be generated simply by burning a small piece of sulphur in the cylinder. In either case



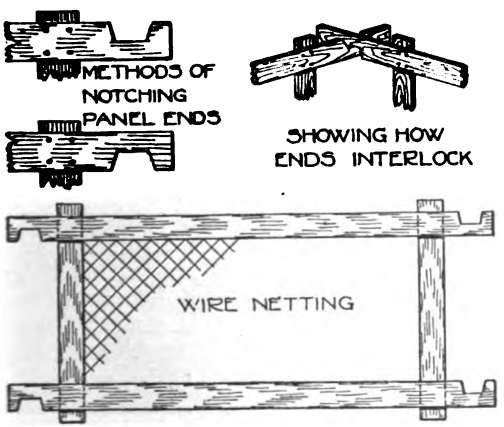
An apparent change of wine into water with the use of sulphur dioxide and permanganate

the cylinder should be covered with a glass plate until ready for use so as to prevent the escape of the gas.

A Handy Portable Fence Built in Sections

MANY styles of portable fences have been devised, but the one illustrated is of such a pattern that the panels may be used for a great variety of purposes.

The panels are 8 ft. long by 3 ft. high



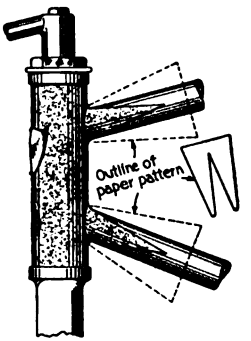
Frames made up of four boards and paneled with wire to make a portable fence

for general purposes; but, of course, the measurements can be changed to suit the conditions under which they are to be used.

By fitting several panels together in their various combinations many purposes can be served, as, for example, a four-sided or three-sided yard for poultry; fencing around a flower-bed, dog-yard or baby-yard, a continuous fence, trellis for flowers and many other things may be made. These panels are easily built of 3-in. "furring" and the required kind of wire. —L. B. ROBBINS.

Paper Stencil for Painting a Bicycle Head

WHEN the bicycle is to be repainted and it is desired to have the head a different color the V-shaped painting on the frame tubes presents considerable difficulty to the amateur painter. The illustration shows how this may be done by using a piece of paper with pointed notches to fit around the frame tubes. When this is put in place it makes a stencil, covering the parts not to be painted. The paper may be held in place with a cord tied around the end over the paper tube of the frame. —WM. THOMLE.



Painting the V-shape on a bicycle head

Polarity Determination for Plating Batteries

STUDENTS of electricity, when first they become acquainted with the subject, often find difficulty in remembering the polarity of the two poles of a battery or electrodes of an electroplating bath.

First, consider the battery. Instead of trying to remember the polarity of both zinc and copper, concentrate the attention on one only. If you can remember that *copper* is *positive*, you will know that the other element, zinc, must necessarily be negative. Bear in mind that carbon and copper, both beginning with C, have the same polarity. Copper is positive and so is platinum.

If the zinc and copper cylinders of a Daniell cell are connected by means of conducting wires to two plates of platinum,

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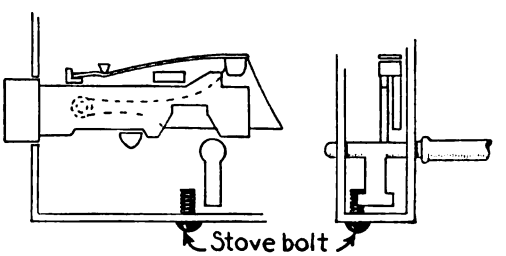
or the ends of the wires are connected together, and these are immersed in a chemical solution made by dissolving a metallic salt in water, they form what are termed *electrodes*. The positive electrode is connected with the copper or positive pole of the battery and, of course, the negative electrode to the negative pole. The effect of passing a current is to split up the salt into its metallic and acid constituents, and these make their appearance at opposite electrodes. The positive electrode is called the *anode* and it is here that acids appear. Oxygen, chlorine, and other non-metallic bodies, which play the part of acids, will be found at the anode. Having fixed this point, it is not difficult to remember that the metal constituent appears at the negative electrode, which is termed the *cathode*.

To further connect the words *negative* and *cathode* in the memory, remember this: Using a solution of copper sulphate and passing a current of electricity through the electroplating vat, the copper is deposited on the cathode; the acid forms around the anode.

Finally, bear in mind that all electro-positive elements appear at the negative electrode; while electro-negative elements go to the positive electrode. —PETER J. M. CLUTE.

Blocking the Skeleton Key in an Ordinary Lock

THE common skeleton key will open almost any of the ordinary door locks on the market. The writer had occasion to look into this after a friend's room had

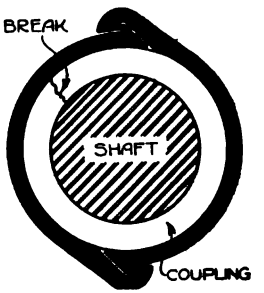


Placing a screw into an ordinary lock frame to stop the skeleton key from turning

been entered and robbed of some fairly valuable tools. Removing and dismantling the lock, a small screw was inserted and tightened as shown by the illustration. The regular key was filed off to allow it to pass over this obstruction, but the lug on a skeleton key would not pass it to throw the bolt back. As the bar bolt and lever lay close to the inside plate of the box a considerable part of the regular key can be filed off and the key will still throw the levers perfectly. This allows the insertion of a fair-sized stove bolt in the bottom of the box to block the skeleton key. Of course, if entrance is desired by a graduate of the lock-breaking art, the finest piece of locksmith's skill and ingenuity amounts to nothing. But the petty lodging-house pilferer can be baffled for a brief time by this clever trick.—F. W. BENTLEY.

Temporary Repair on a Boat Engine Shaft

WHILE on a cruise, the coupling on the main shaft of the boat broke and we had to be towed into port. To make a permanent repair would have cost considerably in money and time, to dismantle the plant and move the shaft, so we simply joined the coupling as shown. The break was closed by the well-known shrinkage process.



Two-part ring to shrink on a shaft

As we could not slip a ring over the shaft, it was made in two halves, each having a hook at one end and a notch or socket at the other. These were forged out so that their inside circumference would be a trifle smaller than the outside of the coupling. When heated they were easily slipped in place over the coupling, and in cooling they closed in on the parts, pulling them together.—JACOB HARSEN.

Treating a Clothes-Line to Prevent Its Stretching

THIS can be accomplished by boiling an ordinary rope clothes-line in water. A new line thus treated will not stretch but will retain its firmness.

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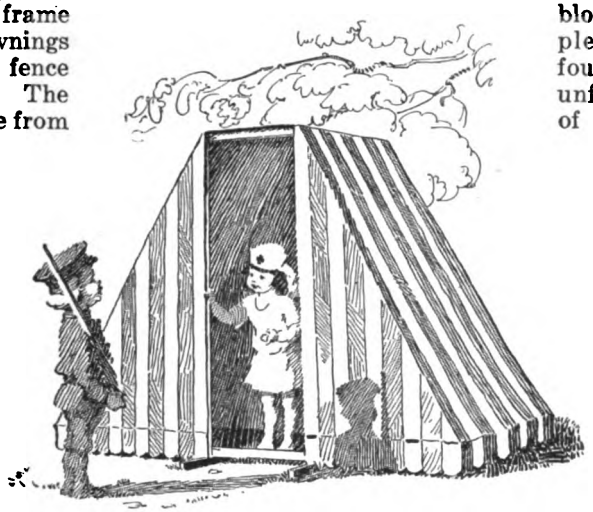
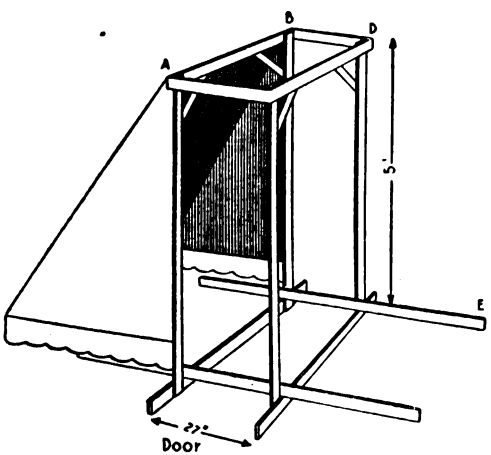
A Child's Play Tent Made Out of Awning Covers

HAVING some old awnings stored, which were too old to put on the windows, a householder made use of them to construct a play tent for his children, as illustrated. The frame for holding the awnings was made from fence pickets 5 ft. high. The width of the frame from *A* to *B* depends on the width of the awnings. At the place marked *C*, about 10 in. from the bottom, the cloth was fastened with screws, using a metal bottle cover for a washer over the cloth. Two awnings were used complete, one on each side, and the third awning was cut apart and used for a cover and a back, allowing the front to remain open for entrance.



Window awnings joined together with an extra piece at the top to make a door in the side



A frame made of fence pickets for holding the window awnings for making a tent

If the two pieces used beneath the frame are made curved at the ends like a sled runner the whole structure can be moved about as desired.—F. P. TONSOR.

An Efficient Substitute for an Automobile Jack

IN case a tire goes flat on the road and, when about to repair it, the jack is missing—having been left in the garage at home, lost or otherwise—and no poles, blocks or other implements may be found to raise the unfortunate corner of the car, proceed as follows:

Scrape up enough rocks, pieces of wood, etc., to build a foundation from the ground up to the lowest substantial point of the said corner, and with a screw-driver, tire tool, axe, hatchet, hand shovel or other appropriate tool, begin to excavate the material from under the tire. As the excavating proceeds the car will settle a little and soon the tire may be removed, repaired and replaced. The hole is then filled as nearly to the original level as possible, the foundation knocked out, and the car proceeds on its way, or, if it happen to be a front wheel which gives the trouble, the engine is started and the car driven off the foundation.

Extinguishing Materials for Fires Caused by Electricity

THE time element is a very important consideration in the extinguishing of electric fires, and there is a good opportunity for the display of good judgment and prompt action.

First, if possible and if conditions warrant it, the current should be cut off from the affected part before the fire is attacked.

Although their use is limited, sand and powdered soda bicarbonate are found to be good extinguishers in certain kinds of electric fires. The sand provided for such usage should have been carefully sifted

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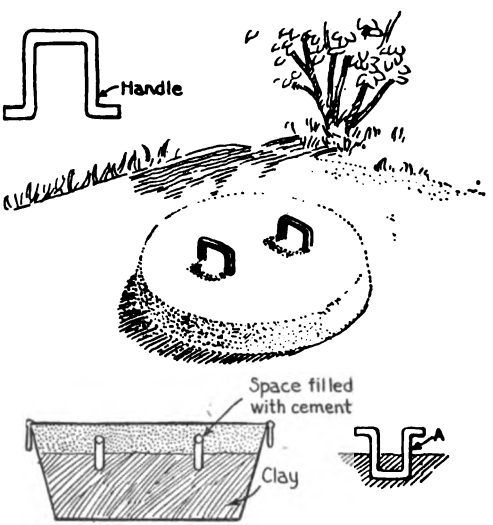
through a fine-mesh sieve to remove the larger particles and foreign matter, and should be stored in a bin in a dry condition. In extinguishing a fire in a machine where the sand might get into the bearings of movable parts, sand should not be used.

For oil fires, wet sawdust saturated with sal ammoniac has been found quite meritorious.

Carbon tetrachloride has stood severe tests as an extinguishing fluid, and has the added advantage of being a non-conductor.—PETER J. M. CLUTE.

Making a Round Cement Cover for a Cistern

THE boy of the house can make a substantial cistern cover by making a study of the illustration. The form for shaping the cover is the top portion of a



An ordinary metal wash tub used as a form for making a round cement cistern cover

wash tub. Fill the tub with gravel or clay, leaving 4 in. of the top unoccupied, smooth and pack the surface of the filling. The heavy rod handles are sunk half way into the clay, as shown at *A*. The concrete is poured around the open ends which stick up into space. The top of the clay should be neatly covered with paper before the mixture is poured. Iron rods may be used for reinforcing, but they are put in after the pouring. Make a mixture of 1 part cement and 4 parts sand and when dry-mixed well, add water and keep turning over until it is like butter. Fill the space in the upper portion of the tub and in 15 minutes strike off the top with a straightedge. After a while smooth it with a wood trowel or float and finish with a steel trowel. Do not touch it for two weeks and then you may turn the tub upside-down and a neat and lasting cover will drop out.—H. ALDEN.

The Economical Use of Gasoline in Automobiles

DURING the past few years gas and gasoline engines have taken the place of steam engines in many power plants and, together with the enormous expansion of the automobile industry, have greatly increased the demand for gasoline. Before the time of automobiles gasoline was considered a by-product in the oil industry and many means were devised to make use of it. Owing to the increased demands for this volatile liquid the refiners have been forced to bring into gasoline heavier elements with a loss of volatility.

With this increase of a heavier oil it has become necessary to provide carburetors that will handle the present-day gasoline in an economical and efficient way. Gasoline cannot be used as a fuel in internal-combustion engines while in a liquid state, and owing to the increased amount of heavier elements it is necessary to have a higher temperature for vaporization. This trouble is experienced more during winter, and it makes economical consumption difficult.

On the older types of automobiles there was no control on the steering post or dash for supplying a change in mixture for starting and operating a cold engine, nor was there any hot-air equipment to facilitate the evaporation of the fuel.

The carburetor should never be adjusted before the engine has been allowed to warm up and the cooling water should reach a temperature of 160 deg. It is impossible to vaporize all of the gasoline at a less temperature, and a rich setting will be the result if the carburetor is set before this temperature is attained. A dash control will enable the driver to reduce the amount of air and increase the amount of gasoline while driving the

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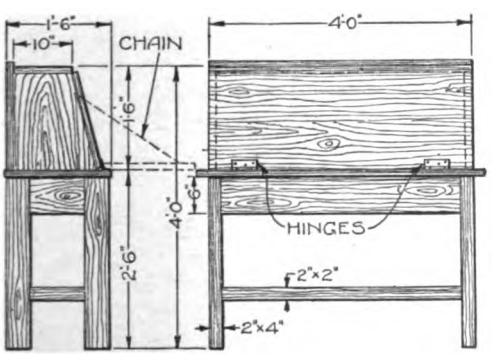
engine cold. While this will limit the flexibility for a time it will prevent the waste of gasoline after the engine has reached the proper operating temperature.

The best method of heating up, as well as of running is to equip the engine with a hot-air stove. This should have sufficient capacity to heat the air entering the carburetor to temperature of not less than 160 deg. The tubing conveying the air from the stove to the carburetor should be of ample size and as short as possible to prevent restriction of the air flow, which would reduce the power. It is desirable to have an adjustable opening in this pipe so that cool air may be admitted on hot days.

The correct ratio of gasoline and air for a perfect mixture is .08 lb. of gasoline to 1 lb. of dry air when the engine is running with cooling water at 160 deg. An increased amount of gasoline will decrease the power. This fact is in a large way responsible for the unnecessary fuel consumption experienced by many motorists, and when adjusting the carburetor it is recommended that the gasoline adjustment be reduced to a point where the engine commences to lose power and then gradually opened until the normal power is attained.

An Inexpensive Field Desk for the Army Camp

THE accompanying illustration shows the simple construction of a field desk. This desk was designed so that it



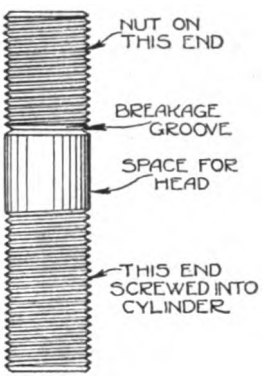
Packing box material was used to make this handy field desk for an army officer

can be made from old lumber or packing cases. The parts are cut from 2 by 4-in. material 2½ ft. long and braced with a 2-in. rail about 8 in. from the lower ends. The upper ends are joined with a 6-in. rail on which the top board is fastened. The top is 1½ ft. wide and 4 ft. long.

The desk part is built up 1½ ft. high with a sloping cover. All the things necessary outside of the lumber are two hinges and some nails. A lock may be attached to the desk for additional security. — GEORGE M. PETERSEN.

Breakage Groove in Cylinder Head Studs

IT sometimes happens that when cylinder heads are blown off a part of the cylinder is broken out, due to the studs being stronger than the metal in the cylinder. This causes a delay in either replacing the cylinder or welding the piece in place. By using a cylinder head stud with a breakage groove in it, as shown in the illustration, the liability of breaking the cylinder is reduced, as the stud will give way under excessive pressure before the head. The size and depth of the groove is governed by the size of the stud and the pressure in the cylinder. By locating the groove as shown the stud can be easily backed out in case of breakage. —J. R. MINTER.



A breakage groove at the thread end

Clamping Pieces for Gluing on a Bench Top

WHEN fastening two or more pieces of wood together, it is usually difficult to hold the pieces tightly together, especially if the work is very wide and no clamps are available.

This difficulty can easily be overcome by placing the work between pieces of wood fastened securely to the back of the bench and a bench-stop in the vise. The vise can be tightened until the pieces are in position and then fastened.

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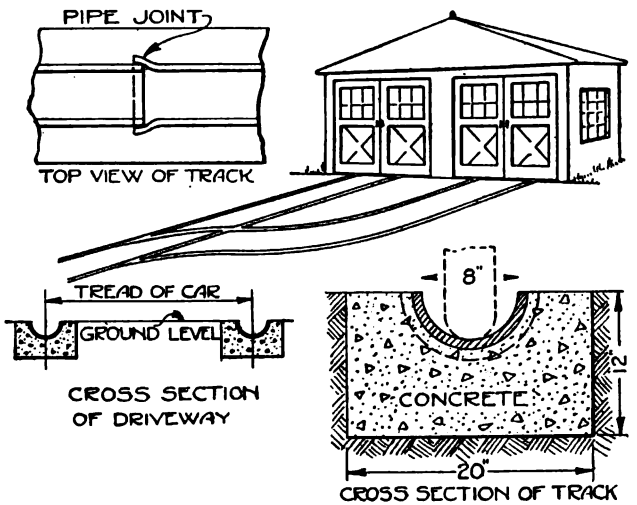
Runway Guide Tracks to Facilitate the Entering of a Garage

PRIVATE garages are commonly placed on a back corner of a lot. It is usually a difficult place to enter with an automobile, and a more difficult one out of which to back a car. For this reason, I made guide tracks, as shown in the illustration. Trenches about 2 ft. wide were dug in the ground at the proper width to accommodate the wheels of the automobile and into these cuts concrete was poured. Halves of earthen soil pipes were then set in their upper surfaces. A cross-section view of the trench and pipe is shown in the illustration.



Guide tracks made of split tile set into a concrete base and their use with a switch for a double garage

Where there are double entrances to a garage, a switch can easily be made by cutting the pipes on an angle. Ordinary 8-in. soil pipe is used and each joint is cut in half, making two pieces. The concrete is laid in wood forms, which are removed after the concrete has set. The soil is filled in close to the concrete, then the surface is covered with sod so that a level surface is produced with the exception of the hollow made by the tile. The hollow of the tile guides the front wheels easily so that in entering the garage a driver need not fear the striking of the door. Such guide tracks may have grass growing close to the surface of the concrete base.—P. P. AVERY.

Secret Door Lock for the Executive's Private Office

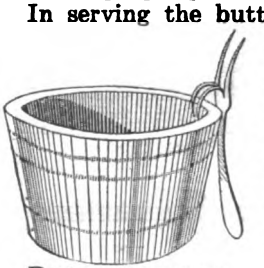
EXECUTIVES often desire privacy, but find it difficult to keep visitors and employes from entering their offices. Of course a clerk stationed at the entrance can somewhat relieve the situation. It would not be feasible to have the door locked at all times, as it would give the impression that the executive's door was not open for visitors, and it would make it rather embarrassing to all concerned should some one, who has authority to enter unannounced, try to get in during the assistant's absence.

A simple electric arrangement, which can be installed by any electrician at a comparatively small cost, connects a bolt in the door with a push button under the desk, so that the officer simply has to push the button to lock the door, without any noise, conveying to the caller the information that the executive does not wish to be disturbed. Another button unbolts the door.—KARL M. WEHINGER.

A Butter-Chip Fork for Use in Restaurants

IN every restaurant where the practice of serving meals in a hurry is the main feature it is necessary to have everything needed for the usual table requirements in their proper place.

In serving the butter chips, or rather in putting them on their respective small dishes from the butter tubs, requires the use of a fork for handling the pieces.



Bent center prongs make holding hook

An inventive waiter devised the use of a butter-chip fork made by bending an ordinary fork in the form of a hook to hang over the edge of the butter-chip tub.—R. O. HELWIG.

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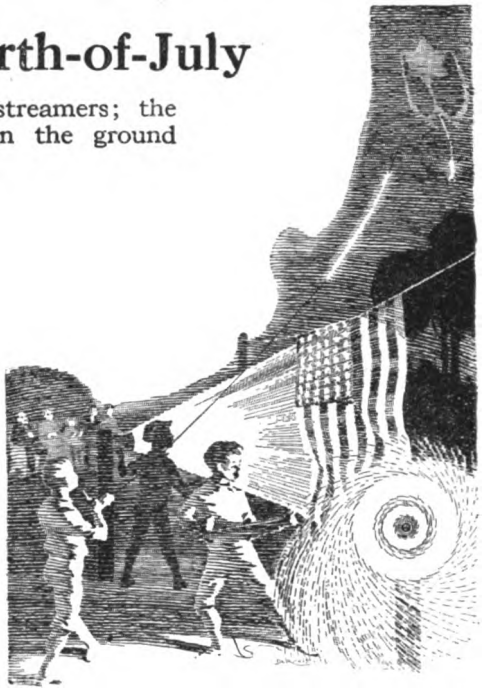
Helps for a Sane Fourth-of-July

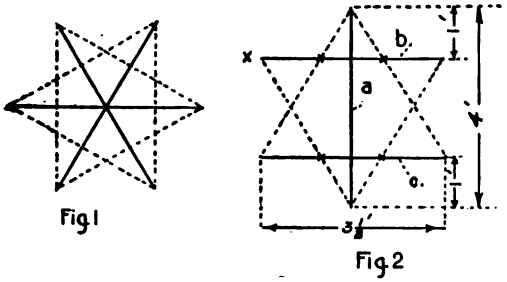
Novelties in the way of kites with streamers; the use of sparklers in the air and on the ground

By C. M. Miller



PATRIOTIC exhibitions are very popular these days and especially so as we near our great National holiday. How shall we celebrate this year? In the daytime we may well turn our attention to kites and kindred air devices, the national colors being exclusively in vogue. There are many-shaped star kites that are beautiful in form and which may be further embellished by the addition of fringes, streamers, etc. The star-and-crescent is not so popular now, as it is found on a flag that belongs to an enemy, but shield shapes and eagle kites with suspended star-spangled banners thrill us at any time. Hot-air balloons may also be made up of the National colors in tissue paper, and gas balloons may be sent up in groups, too. Large parachutes can be released from the kite lines high in the air, or a score or more of small ones may be released at the same time to come floating down "somewhere in America," not very far away from the starting place.

One kite may be made red, another white, a third blue, and this may be repeated, all being attached to one line;



A six-pointed star kite made with three sticks with cross bar or a spine

if they fly well, the number can be increased to fifty or more. It is well to so adjust the bridles that one will stand out on the right, another to the left, and so on, the effect being more beautiful.

Sometimes a kite line is decorated with pennants for a long distance and these may vary in lengths, some being 3 ft., some 10 ft., and so on. If these are turned on the edge a little, like a small hem, they will wear better. They should be placed quite a little distance, perhaps 20 ft. or more, apart.

A beautiful exhibition is the unfolding of a good-sized flag far up in the air. It may be rolled up and at the right time released by an extra string to the ground.

Airplane kites will be attractive and popular. They may be decorated with identification marks as is used by our aviation designs. These kites will require careful making and should be started sometime before they are to be exhibited. They are of the box-kite order and need more tryouts to get good balance, etc., before they can be relied upon.

The six-pointed star kites are the most familiar perhaps as regards the making. They may be made with three sticks crossing each other, as in Fig. 1, or they may be made with a spine, *A*, Fig. 2, and two bow sticks *B* and *C*. In either case the string is stretched from one point to a second point beyond in series around the kite. Supposing one end of *B* was a beginning, the string would pass to the bottom of *A* and then up to the other end of *B*, called for convenience *X*. Next a string would pass from the end of *C* to the top end of *A* and down to the

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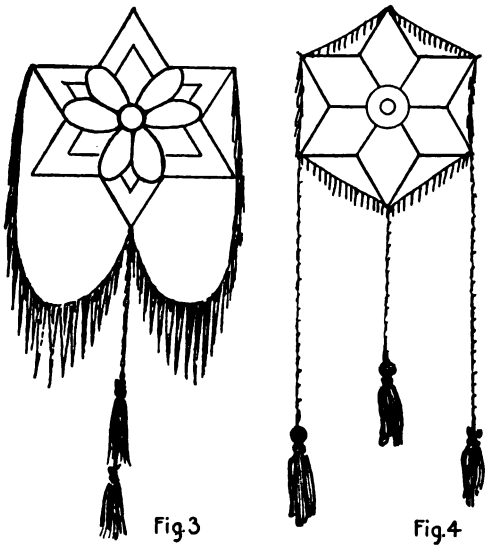
other end of *C*. These lengths of string should be all the same. If we should make a 4-ft. kite, the upper cross piece *B* of Fig. 2 would be down 1 ft. from the top end and the cross piece would be 3½ ft., *A* being 4 ft. If the spine *A* was



Fringes attached to festooned strings or tails may form a very attractive decoration

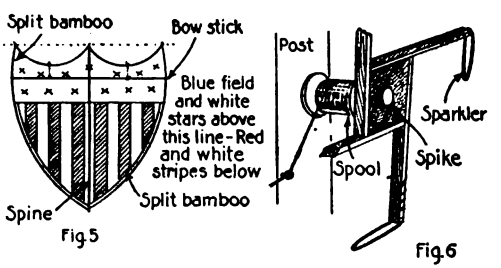
3 ft. the cross pieces would be about 6 in. from each end of *A*, and these pieces would be about 2½ ft. long. A string all the way around the outside ends helps to strengthen and gives opportunity for attaching fringe. The fringe is not necessarily limited to the short lengths of paper, but ribbons of paper 2 ft. long would be very pleasing. Fringes may be attached to festooned strings from the ends of *B* to the bottom of *A*, as in Fig. 3. The tails may be a very attractive part of the kite, as in Fig. 4. The trailing lines are very artistic but they should not be the same length.

The tailless kite may be easily shaped into shields, etc. In Fig. 5, the spine is 4 ft. and also the cross stick, their union being 10 in. down from the top of the spine and placed in front where they are lashed together. The curved outline will require some split bamboo which is lashed to the bottom and top of the spine and at both ends of the bow stick. The depressed bows at the top will need to be tied down to the spine as shown.

In covering, the blue field should extend about 6 in. below the bow stick, otherwise the upper portion will look small in comparison. In putting on stripes, cover with red or white and then paste strips of the other color over the first ones.

At night colored lanterns can be carried up by kites so that they will hang in the sky, but the more interesting are the safe light exhibitions by means of sparklers, red light and similar mediums. An attractive device is the whirligig which may be arranged with different lengths of arms from the center block so as to produce a spiral effect. A square block of wood, 1 in. thick and 3 by 3 in. is nailed to a large-sized spool and a hole is put through the block so that a large-sized nail can be put through both to fasten the device to a post of some kind, as shown in Fig. 6. The nail must not be driven in too tight as the spool must turn freely. A screweye placed a little way from the spool will prevent the entanglement of the string with the arms carrying the sparklers. The string is wound on the spool and, when pulled, unwinds and causes the device to turn. The arms may be ¼ by ½ by 8, 12, 16 and 20 in. respectively. The sparklers can be wired to the arms with small wire and should be turned back in the direction opposite to that in which they are to move. Use about 50 ft. of strong cord, not too large.

A pleasing exhibition is the illumination of a flag. A new can or bucket may be used as a reflector and the box of fire powder (red perhaps) may be set inside.



A tailless kite is easily shaped into shields with split bamboo lashed to the parts

The flag may be suspended all the time or may be rolled up and released at the right time; the latter is more effective. The light must be so confined as to shine just about the flag. The side of the can may be cut so as to force the tin back, opening up sufficient to let the light out

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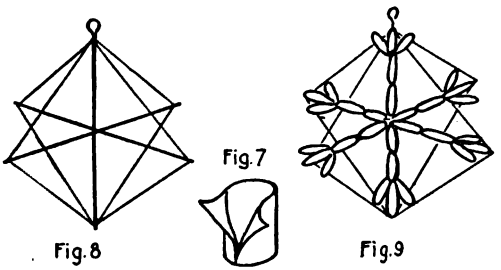
on the side of a flag as in Fig. 7. It is not necessary to have a top in the can. Any tinner can cut the side for you if you do not possess a pair of tinner's snips, or a can opener will do the work.

An easy stunt is to bend the ends of the wire of six or eight sparklers so as to form a loop on each and with a string, perhaps 15 ft. long, tie these sparklers at



A light reflector for a flag and a frame to fasten on sparklers for an attractive design

regular intervals. After the sparklers have been lighted two persons turn the string like a skipping rope. This can be further extended by adding three or four groups of skipping ropes of light. To light these sparklers, collect all of a string without entanglements so that the ends may be brought together in a bunch with the lighted sparklers; the heat being intense, the lighting must be done quickly.

One might insert a wire in a kite line and with a suspended wire from this section attach sparklers so that they would touch each other and as one burned to the end it would light the next. To get the lighted sparklers in the air, the device should be worked up well into the air before lighting, then someone should follow along the line and draw the line down gradually, leaving another person holding the string at the starting point. When the device is reached the lowest sparkler would be lighted and the string released at this point; then the pull would come back to the starting point and thus raise the device up in the air again. By a little manipulation the device could be made to whirl around the kite line.

An illuminated spray from a garden hose may be planned as follows: Take a tin can about 6 in. in diameter and high enough to hide the direct light of the fire. Make a hole about 1 in. from the bottom large enough to receive the garden hose. Screw on the sprinkler after the end of the hose is inside. Place a block of wood in the bottom as a rest for the sprinkler and set a red or green fire-powder box in the bottom of the can. Light the powder and turn on the water. The fire should not be placed under the hose, but to one side.

If there is plenty of room, blunt-pointed darts may be used to propel lighted sparklers through the air like falling stars. The dart is thrown with a springy stick and string, and will take the lighted sparkler high in the air. Care must be taken that these do not alight on inflammable material before they are burned out. Very pretty effects are obtained by a group flinging the lighted sparklers by hand, one group throwing to the other. Good sparklers may be thrown two or three times each.

Set pieces of beautiful designs may be easily worked out and all of this will be much enhanced if the windows of the homes are illuminated with the National colors, and lanterns are hung in the porches and from the trees of the yard; these, too, of the red, white and blue.

A frame for a very interesting piece can be made of wire, as shown in Fig. 8. The three heavy lines are for the framework, and the light lines are light stay wires. The sparklers are wired to the frame, as shown in Fig. 9. The sparklers must overlap each other sufficiently to light the succeeding ones. The light is applied to the center and in a short time six sparklers are burning; as the outside arms are reached, eighteen are burning at one time. The design can be modified in many ways so as to make a more extended illumination. Thirty sparklers are necessary for the design in Fig. 9.

An illumination of the flag that is not original, is to carry an electric cord to the top of the flag pole and with a bulb housed in a reflector, so that it will not be in view from below, throw the light on the flag. It would be very fitting if all of our homes might have this last exhibition on July 4, 1918.

Kites of the designs shown and the whirling devices are not expensive to make and the kinds of illumination not costly, which should be in the minds of every patriotic citizen during our struggle with war conditions and to celebrate the day in which our independence was declared.

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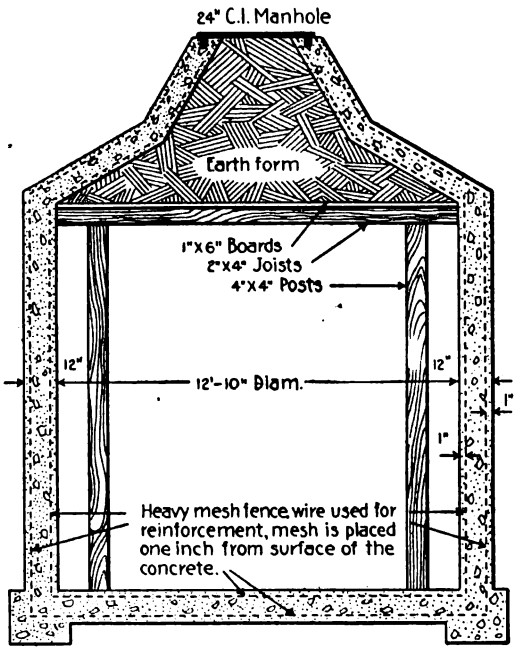
Concrete Cistern Used for Water Pressure Supply

THE cistern illustrated is located above ground or at some convenient place or high spot on the farm so that it will be possible to have water under pressure in all the departments of the farm. The water is pumped into the cistern by the farm windmill or gas engine. If a hill or high place is near, the cistern may be placed beneath the ground, which is much better than above the surface, and for the beginner is a much better form to construct. Details will be for the underground cistern. The cistern is round, 12 ft. in diameter, and, for the average farm, about 14 ft. deep. Dig the pit about 2 ft. larger on each side so that there will be room enough for a person to climb down beside the forms to fasten them securely. It is very essential in this work to have everything true and plumb and have the forms solid and secure to prevent any bulging. Build the floor first, which should be at least 10 in. thick and reinforced with heavy wire mesh fencing such as is used in the walls. Let the reinforcing steel project up at least 2 ft. all around the floor so that when the walls are built it will make the bond complete and a very solid joint. Let the floor harden for a day or two before the forms are set for the walls.



Construction of a concrete casing for a cistern or water tank set on a high place for supplying farms or country houses with water

The wall forms are not difficult to build. They consist of battens, 3 in. wide and 3/8 in. thick, which can be purchased from a local lumber yard. These strips are easily bent to a 12-ft. diameter; then nailed to uprights of 2 by 4-in. material. Build the forms on the outside of the pit, then set them in place. The outside form will have a diameter of 14 ft. When the two forms have been set, wire them together and to each upright, to prevent any possible bulging when the heavy concrete is poured into them. When the forms are removed, clip the wires off even with the concrete. Build the cover over a clay form as shown. Moist clay is packed in the proper shape on a false floor made of 6-in. boards supported on posts. A cast iron ring should be set into the concrete while it is soft.

The best concrete mixture for this purpose is 1 part cement, 2 parts sand and 4 parts clean, well graded gravel. Mix the concrete to a "quaky" consistency and use care in setting the forms and the reinforcement, so that the whole cistern will be a permanent structure. In making two forms with a space between for the thickness of the wall they can be used in a pit or outside as desired. If the cistern is placed in a pit the earth is filled in after the concrete has set.—W. E. FRUDDEN.

Solution to Make Drill Point Bite Into Tempered Steel

THE worker in steel often finds it desirable to bore holes in parts of machines that have been tempered. By using the following solution on the drill point, a hole can easily be bored through a tempered steel spring or other machine part. Make up a strong solution of camphor in turpentine, shaking the bottle until the camphor is dissolved. Put the drill on as slow a speed as possible and keep the cutting edge continually wet with the camphor solution.

The camphor may be readily dissolved in a small quantity of alcohol and then added to the turpentine.

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Electrical Devices and How They Work

VII.—Electrochemical Decomposition

By Peter J. M. Clute, B. E.

WHEN a quantity of electricity is passed through a dilute sulfuric-acid solution, using platinum electrodes immersed in the acid, gas is evolved at each electrode. These gases may be separately collected in tubes filled with the solution and inverted over the electrodes, as shown in Fig. 1. The gas liberated at the positive electrode is found to be oxygen, while that at the negative is hydrogen; and the volume of hydrogen is just twice the volume of the oxygen. These volumes are exactly in the ratio in which the gases combine to form water, (H_2O), and on this account it was first supposed that the current directly decomposes water.

Current passing through a conducting liquid of a compound nature, called an electrolyte, decomposes the liquid. The electrolyte is always decomposed during the passage of the electric current, and the process of decomposition is called electrolysis. In Fig. 2, the plates suspended in the solution are called the electrodes, the positive plate, by which the current enters the solution, being the anode, and the negative, by which it leaves, the cathode. The passage of the current is attended by the movement of dissolved particles through the solvent toward the two electrodes, and it is by means of these particles that the current is carried. The moving particles are termed ions (from the Greek, meaning "to go"), those moving toward the anode being called anions, and those toward the cathode, cations.

During electrolysis, decomposition products of the electrolyte are deposited on the electrodes or concentrate about them. Thus, when copper chloride undergoes electrolysis, the copper is deposited on the cathode, while the chlorine gas is set free at the anode, the products of decomposition thus appearing at places which are a distance apart.

The most common electrolytes are solutions of compounds in water, but most compounds that conduct electricity may be considered electrolytes, or conductors of the second class, as they are frequently called, to distinguish them from elementary conducting substances, which, of course, cannot be decomposed and are classed as conductors of the first class. Conductors of the first class have an increased electrical resistance with increase in temperature and are not decomposed by an electric current; those of the second class have a decreased resistance with increase in temperature and can be decomposed by a current of

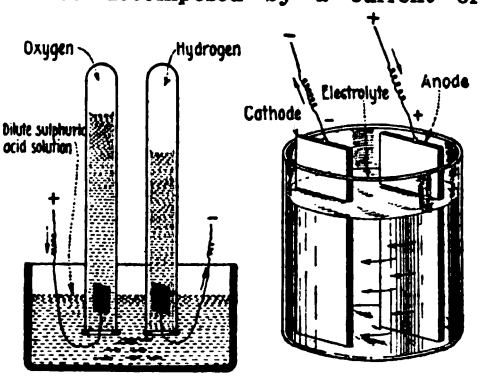

Fig. 1 Fig. 2

Decomposition of water by a current of electricity and an electrolytic cell

electricity. These are the distinguishing characteristics of the two classes of electrical conductors.

The earlier conceptions of electrolysis supposed the decomposition of the electrolyte to be effected by the electric current, but it is now believed that a large percentage of the electrolyte is ionized, or broken into positively and negatively charged ions, as a result of going into solution, and that the electric force in the electrolyte is simply directive, causing the positively charged ions to move with the current and the negatively charged ions to move in the opposite direction through the solution until they reach the electrodes where their charges are released and the molecules are set free in the neutral state. (See Fig. 3.) The current is supposed to be made up of the charges which are thus carried convectively by the moving ions.

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All the molecules of a compound are not dissociated into ions except in very dilute solutions in which the solvent has a strong ionizing power; that is, a power of resolving molecules into ions. Also, liquids vary as to ionizing power, water being one of the strongest. Many organic liquids do not ionize molecules at all; and some compounds are not ionized in any solution. All conducting solutions contain ions; non-conducting solutions do not.

When an electrolyte is decomposed, the amounts of the various substances liberated are proportional to the quantity of electricity passing through the solution. The amount by weight of any element that will be liberated by a given quantity of electricity is proportional to the chemical equivalent of that element. Thus, for instance, a quantity of electricity that will liberate 1.008 grams of hydrogen will also liberate 8.0 grams of oxygen, or 63.57 grams of copper, or 107.88 grams of silver, etc.

The amount, in grams, of any element that will be liberated by one coulomb of electricity (one ampere per second) is the electrochemical equivalent of that element. This quantity has been carefully determined by research for the element silver and has been found to be .001118 gram. The method employed is as follows: Referring to Fig. 2, an electrolytic decomposition cell similar to that shown is used. Anode and cathode are of silver, dipping in an electrolyte, which is a solution of a salt of silver, generally silver nitrate ($Ag\ NO_3$). The cathode is carefully cleaned and weighed before being placed in the electrolyte, and after passing a known current for a definite time through the solution, the cathode is removed, carefully dried, and again weighed. The increase in weight, in grams, divided by the total quantity of electricity passed through the cell, gives the weight in grams deposited by one coulomb, which is the electrochemical equivalent of silver. The electrochemical equivalent being known, it is apparent that such an arrangement can be employed in the measurement of electric current, and the apparatus used for this purpose is termed a voltameter.

The following table gives the electrochemical equivalents of some well-known substances. It will be noticed that they are proportional to the combining equivalents:

In the process of electroplating, advantage is taken of the fact that when an electric current is passed through a solution containing the salt of a metal, the metal will form a deposit on the negative electrode.

Referring to Fig. 4, consider the process of copper-plating. The iron rod to be plated is placed in a copper-sulfate solution ($Cu\ SO_4$), together with a strip of copper, as shown. When current passes through the cell, it decomposes the copper-sulfate solution into a copper part, Cu, and an acid radical, SO_4. The copper, being positively charged, goes with the

ELECTROCHEMICAL EQUIVALENTS

Element	Symbol	Atomic Weight	Valence	Chemical Equivalent	Electro-chemical Equiv.
CATIONS:					
Copper	Cu	63.57	I	63.57	.00065883
Gold	Au	197.2	III	65.75	.00068090
Hydrogen	H	1.008	I	1.008	.00001044
Nickel	Ni	58.68	II	29.34	.00030404
Potassium	K	39.1	I	39.1	.00040555
Silver	Ag	107.88	I	107.88	.00111800
Tin	Sn	119.0	II	59.5	.00061636
ANIONS:					
Chlorine	Cl	35.46	I	35.46	.00036710
Oxygen	O	16.00	II	8.0	.00008283

By means of the table given above, the amount of any metal necessary to produce a given current for a certain length of time, can be easily determined

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current in the solution to the negative electrode, the iron rod, and forms a deposit on it, thus giving it a coating of copper. The acid radical, SO_4, having a negative charge, goes against the current to the positive plate, and combines chemically with it, forming more copper sulfate.

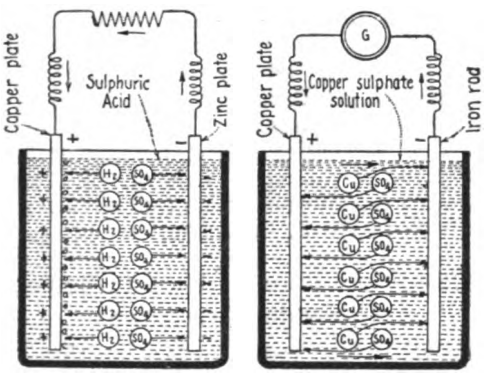

Fig. 3 Fig. 4

Electrolytic action within a simple cell and a chemical action in a plating bath

Thus, the copper strip is gradually consumed and deposited on the iron.

When it is desired to nickel plate, a piece of nickel is used for the anode, instead of copper, and nickel ammonium sulfate for the electrolyte, in place of copper sulfate.

Since one ampere-hour of current flowing through an electroplating bath will deposit a definite amount of pure metal on the negative plate, unknown

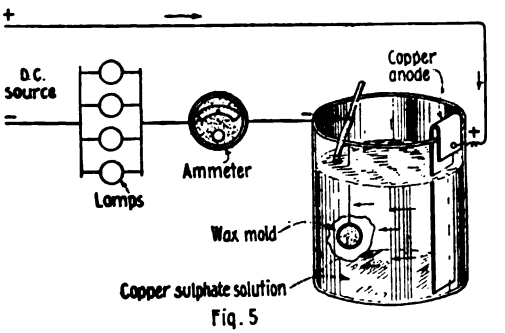

Fig. 5

An electrotyping solution in jar with proper connections to a direct current

currents can be very accurately determined by finding the increase in weight of the plate after a definite period of time. It is from a similar consideration that the following definition for the unit of current, the ampere, has been established:

An ampere is the rate of flow of a steady current which deposits 4.075 grams of silver per hour from a solution of silver nitrate diluted to a standard density with pure distilled water.

One of the methods wherein electroplating is of commercial use and importance is in electrotyping. The object of this process is to reproduce for press-work printers' set-up type, engraving, etc. First, a wax impression is made of the set-up type; since wax is a non-conductor of electricity a thin coating of powdered graphite is next given the mold. The wax mold with its graphite coating is then immersed in a copper sulfate solution together with a copper bar. An electric current being passed through the solution, copper is deposited in the graphite similarly to the method in which it was deposited in the electroplating vat. A plate of sufficient thickness for safe handling is obtained before the circuit is broken. The wax impression is then melted off in hot water and the remaining copper plate is an exact reproduction of the type. After being backed with type-metal, an alloy of lead, the electrotype is ready for use.

In the processes described, the metal deposited on the negative plate or electrode is remarkably pure, and methods similar to these are often employed to separate metals from impurities. The impure mass being connected as positive plate, upon the passage of current, the pure metal is gradually dissolved by the electrolytic solution and transferred to the negative plate. Practically all the impurities remain at the positive electrode, and thus the negative plate will be found to have obtained a thick coating of very pure metal.

(*To be continued*)

Taller Towers at Nauen Station Increase Sending Range

IMPROVEMENTS made in the wireless station of the German government at Nauen enable it to transmit signals 6,200 miles. It now has several additional towers, ranging in height from 890 to 360 ft., which are employed in transmitting wireless messages.

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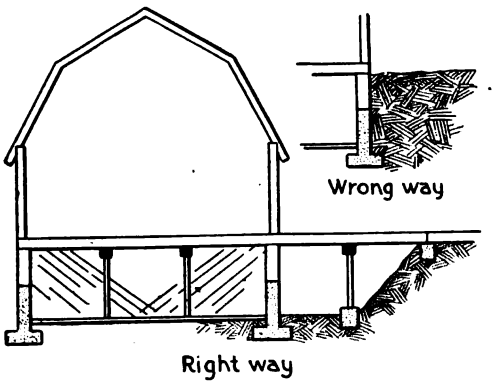
The Construction of a Sanitary Bank Barn

THE old-fashioned stable under a bank barn is always warm in winter and cool in summer, but it is usually so



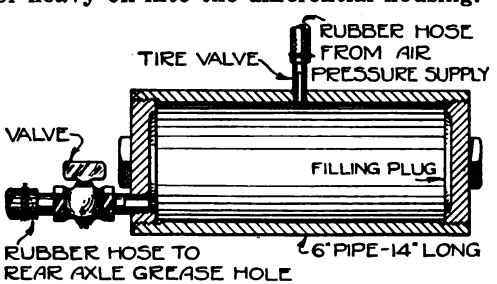
Right and wrong ways of building a barn near a bank to make conditions sanitary

damp that it is an unhealthy home for the stock housed within its walls.

The illustration shows the old style bank barn, and also a way to construct a sanitary barn that will be warm or cool in the proper seasons, yet light and well ventilated from all sides. The bank is kept far enough away from the wall to prevent dampness. The upper floor may be easily reached by means of a bridge. —W. E. FRUDDEN.

A Grease-Filling Pump for the Automobile Rear Axle

THE average car owner always dreads the operation of putting light grease or heavy oil into the differential housing.



An air-pressure grease-filling device for use on the rear axle of the automobile

It is always a slow process with a small hand grease gun to put 4 or 5 lbs. of grease through a 1½ or 2-in. hole. A pump can be easily made that will greatly aid in doing this work in a cleanly manner. Procure a piece of heavy iron pipe 14 in. long by 6 in. in diameter and fit it with a plug at each end. In one plug, near the lower edge, drill a ½-in. hole and turn in a nipple with a shut-off valve. To this valve clamp a piece of heavy ½-in. hose about 5 in. long. In the top of the large iron pipe drill a ¼-in. hole and fit in a regular tire valve. Connect the valve on the top with the regular air pressure, same as if for inflating a tire. Open the valve near the hose that leads to the hole on the differential housing and the grease is forced in quickly. This will be found to save considerable time and is efficient and cleanly.—P. P. AVERY.

Telephone Receiver Used to Detect Grounded Armature

A SIMPLE method for locating a grounded coil in an armature will appeal to all electricians having to care for motors or generators. The test described can be made without removing the armature.

Remove all the brushes from the commutator with the exception of the two

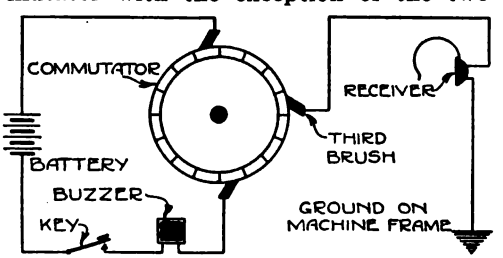


Diagram showing how to make test for a grounded coil without removing armature

located diametrically opposite. These brushes are connected to a few cells of dry batteries and a buzzer, as shown in the sketch.

A telephone receiver has one terminal connected to the frame of the machine, while the other terminal is connected to a third brush, which bears on the commutator midway between the other two.

On starting the buzzer a sound will be heard in the telephone. The armature should be turned slowly, keeping the brushes in the same relation to each other, until no sound is heard in the telephone; this will indicate that the bar connected to the grounded coil is under the middle brush.

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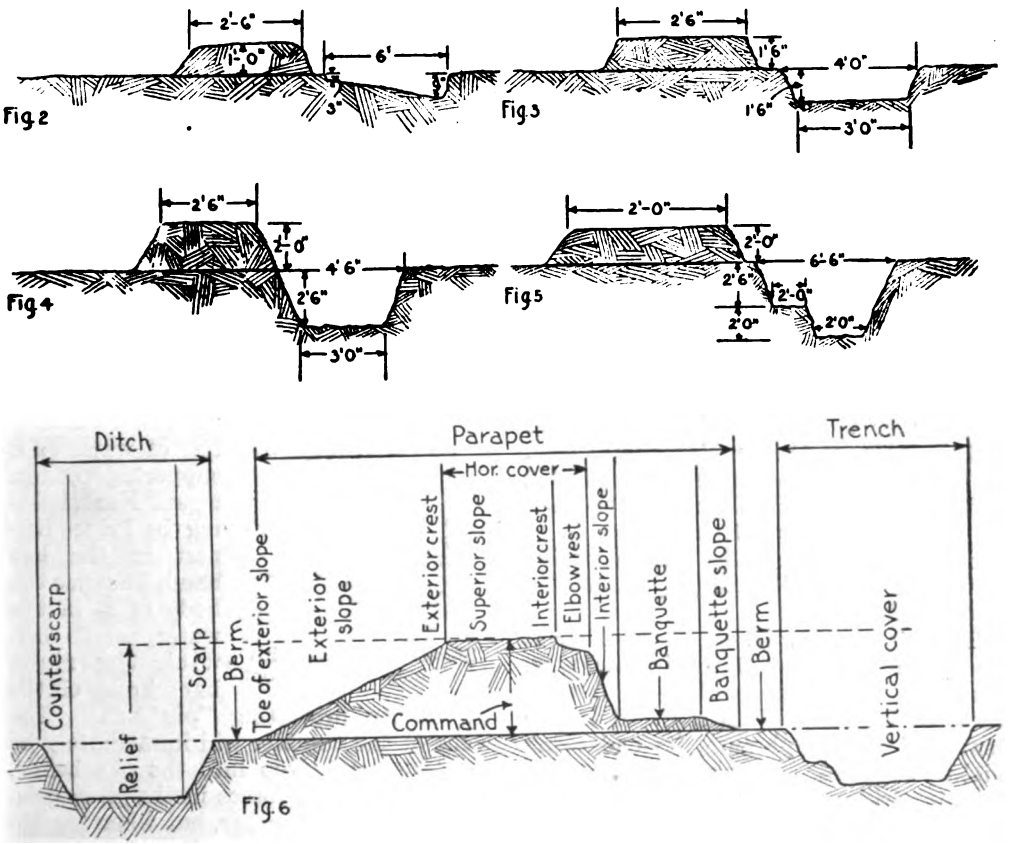
"Digging In" and Making Army Field Fortifications

As looked upon by the general public, intrenchments and field fortifications in general require considerable time to build and the remark is often heard, "I wonder how they could intrench at that point." Certain types of fortifications in the field do require considerable time, but the most commonly used trenches are built or can be built under fire. They are simply a case of evolution from one little hole in the ground to an elaborate intrenchment.

Fig. 1. One soldier firing at the enemy while the second is digging out a small burrow for himself

In Fig. 1 we see two soldiers, one of whom is firing at the enemy while the second one is excavating a small hole for himself. After the first soldier "digs himself in" he will take up the firing while his "bunkie" also digs a little hole. By connecting these "holes" together, as quickly as the enemies' fire will permit, they soon have the "lying trench" shown in Fig. 2, and from then on the work of completing the fire trenches is comparatively simple. The lying trenches are gradually deepened and enlarged until we have the "kneeling trench" shown in Fig. 3, and later the "standing trench" shown in Fig. 4 and 5, the latter being a complete standing trench. It is hard and dangerous



The earth is excavated from the lying trench until the different stages are reached; the kneeling and standing trenches are thus constructed. It is hard and dangerous work as it is done under fire

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work, this digging in under fire, but in many cases it must be done in order to hold ground which has been won, often at fearful cost.

A completed trench, shown in Fig. 6, gives the names of the various parts. The "ditch" in front of the parapet and the ground in front of the ditch are filled with obstacles, barbed wire entanglements, trees, stakes, spiral wire and all sorts of obstructions which will cause confusion among the enemy when they attempt to storm the position. Of course the artillery usually blow the entanglements and obstacles to pieces before the infantry attempt to make an assault, but even then the shell craters make a quick rush out of the question.

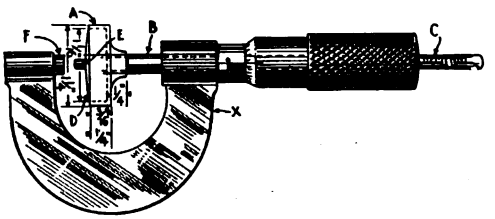
The trenches are generally attacked under cover of a barrage fire, a rain of artillery shells, under protection of which the infantry advance slowly toward the enemy. The barrage fire is lifted every few seconds so that the infantry may keep advancing slowly but surely and, at a set time, the artillery fire ceases and the infantry plunge forward rapidly to make the attack.—GEORGE M. PETERSEN.

How to Make an Efficient Hydrostatic Micrometer

IN the construction of this gage an ordinary micrometer must be used. A hollow chamber, *A*, with an attached hub is accurately turned from a piece of machine steel 1¼ in. in diameter, to the dimensions given in the illustration. A hole is drilled in the hub to fit over the hammer or spindle of the micrometer. This spindle, if the regular one is used with the micrometer, must be annealed and a ⅛-in. hole drilled centrally through it. This is for a small glass tube, *C*, (a clinical thermometer tube will do), which is inserted so that its end projects a trifle into the chamber *A*.

The diaphragm, *D*, is made of sheet steel or brass, about .02 in. in thickness, and slightly cupped as shown. A gage point or hammer, *E*, is soldered to the center of this diaphragm, its end being slightly rounded. For this purpose use a 3/16-in. drill rod with its end slightly rounded and tempered. The diaphragm is soldered around its edge to the chamber face *A*.

The chamber of *A* is filled with mercury or alcohol, colored red and forced on to the spindle, *B*. The thermometer tube, *C*, is also filled with the same liquid so that when the part to be measured is placed between the hammer, *E*, and the anvil, *F*, any displacement or movement



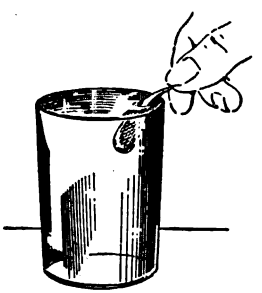
An ordinary micrometer fitted with a hydraulic hammer for efficient measurements

of *E* is transmitted to the diaphragm, which in turn acts on the liquid in the chamber, *A*, forcing it into the thermometer tube, where the variation can be seen.

The accuracy of this device depends on the diameter of the diaphragm, how well made and the size of the hole in the thermometer.—R. S. MYERS.

Shattering a Tumbler Without Touching It

PROCURE some Prince Rupert drops, drawn-out globules of molten glass, which have solidified in the form shown in the illustration. Your local druggist can supply you or they may be obtained from any scientific supply company.



Shattering a glass with a Prince Rupert drop

Then set a thin-walled tumbler full of water on a support, placed in a pan. Next, holding the Prince Rupert in the left hand, immerse the body of it in the water, and then with the right hand break off the tip of the projecting "pig tail." The walls of the tumbler will immediately be shattered and drop into the pan below.

The molecular forces in the glass drop just balance each other, but when the tip is broken off this balance is destroyed and the solid glass bursts.—FLOYD L. DARROW.

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Wireless Work in Wartime

XII.—How the radio receiver works

By John V. L. Hogan

SINCE in the articles for the past few months we have studied various forms of spark transmitters for wireless telegraphy, and thus seen how radio waves are sent out from one station into the ether and along the earth's surface in all directions, we should now look into the ways and means available for receiving the messages. Remembering that the telegrams are spelled out letter by letter in groups of radio waves forming dots and dashes, it is easy to see that in order to write out the words of the message the operator at the receiving station must have some apparatus which is capable of intercepting the groups of radio waves as they pass by. This is the main purpose of the receiving apparatus.

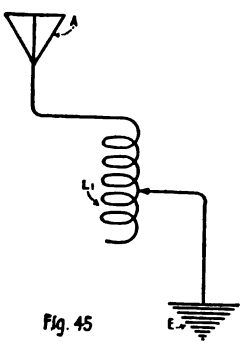

Fig. 45

The simple tuning of an antenna circuit

It is a useful property of the wireless waves that they will produce currents of whatever frequency they may have, in any conducting body which they strike. Thus, if we project into the air a system of wires arranged so that passing radio waves must strike them, we should expect the waves to set up radio-frequency currents in the wires. This is exactly what does happen at receiving stations; a number of aerial or antenna wires may be supported high in the air, by means of a mast, and connected to the earth through a variable inductance or tuning coil, as shown in Fig. 45. In this diagram the aerial is indicated by A, the earth by E, and the tuning coil by L_1.

Tuning the Antenna Circuit

The purpose of the tuning coil is to make the antenna-to-ground circuit adjustable to the condition which will result in securing the largest possible current from any particular desired radio wave. This result will generally be secured when the inductance of the coil is set at the value which makes the "natural frequency" of the aerial-to-ground circuit practically the same as the frequency of the radio waves; this is a condition of approximate or exact resonance, similar to that which is used at the transmitter, and merely indicates that the natural swings of current up and down the aerial-ground circuit occur at the right intervals to cooperate with the impulses set up by the waves. The addition of the two forces (i.e., that of the oscillating current previously produced in the antenna circuit, and that of the waves) going hand in hand results in the largest possible current flowing through the coil L_1.

Thus we have, in Fig. 45, a combination of apparatus which will give us a radio frequency current produced by the energy of passing radio frequency wireless waves. If the transmitter which is sending to us uses a 500-cycle alternator and a quenched gap properly adjusted, and is "tuned" to emit a wavelength of 600 meters, groups of waves having the wave frequency of 500,000 per second and separated by intervals of 1/1000 second will pass by our receiving aerial. These will set up groups of oscillations or high frequency alternating currents in our receiving system, the currents having the same wave frequency of 500,000 per second, and the groups occurring at the rate of 1,000 per second. No telegraph sounder or telephone receiver will give a direct indication which the operator can "read" if such high frequency currents are applied directly to it; and so some additional conversion of the signal energy is necessary before we can interpret the signals.

Increasing the Received Voltage

One of the best ways to apply the radio-frequency current energy to the converting device is to transform it to potential in a condenser. This may be done by adding the secondary circuit formed of the secondary coil L_2 and the condenser

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C_1 which are shown in Fig. 46. It will be noted that the coil L_2 is placed near to the antenna circuit or primary coil L_1, so that the magnetic field of L_1 will induce currents in the secondary circuit by the coils' transformer action. Thus the groups of radio frequency currents set

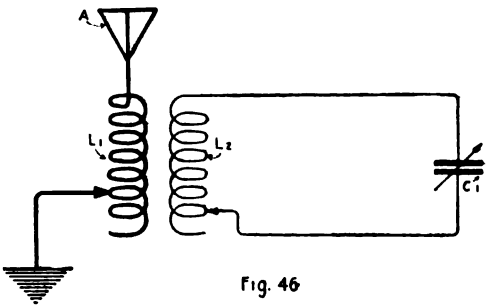

Fig. 46

Showing how the radio-frequency current is applied to the converting device

up in the antenna circuit by the arriving radio waves can now produce further groups of currents, of the same frequency, in the secondary circuit. In order to make the secondary currents as large as possible, the inductance of the coil L_2 and the capacity of the condenser C_1 are made variable; thus the "natural frequency" of the secondary is adjusted to agree practically with the frequency of the waves and of the tuned primary (or antenna) circuit, and, as in the other case, the cooperation of the two sets of currents pile up on the condenser C_1, in the form of radio frequency voltage; and hence, so long as each group of oscillations exists in the secondary circuit, the potential of the secondary condenser varies from positive to negative at the frequency of the waves. By making the coil L_2 of large size, while at the same time keeping the capacity of C_1 sufficiently small not to change the tuning condition (which depends upon the *product* of inductance and capacity multiplied together), the highest possible radio frequency voltages are secured from any particular radio wave.

Converting the Radio Currents

The secondary circuit contains currents and voltages which are still at the exceedingly high (and consequently inaudible) radio frequency of the waves, and which consequently cannot be used directly to produce signal tones from a telephone receiver. If, however, we complete the receiver by adding the instruments shown in Fig. 47, we can translate the dots and dashes made by the sending operator, into short and long tones which may be read as Morse characters. The three new elements are the detector D, the telephone condenser C_2, and the telephone receiver T, though in Fig. 47 the inductance of the aerial circuit is shown in two parts, L_1 or the primary coil itself being used to excite the secondary coil L_3, and the other portion L_3 being made variable and to tune the aerial circuit.

The detector D is shown as a "contact rectifier" of the kind represented by a piece of steel piano wire resting lightly on the surface of a galena crystal. This apparatus has the curious faculty of passing current easily in one direction but of offering an extremely high resistance to current which attempts to pass in the other direction. Consequently when the rapidly alternating voltages on the secondary condenser C_1 endeavor to force currents first one way and then the other, a substantial amount of electricity passes only in one direction. This "rectified" electricity charges the telephone condenser C_2 and then discharges back through the telephone windings, producing a movement of the telephone diaphragm. Since one charge of the condenser C_2 is generated for each group of radio waves, a transmitter of 1,000 sparks per

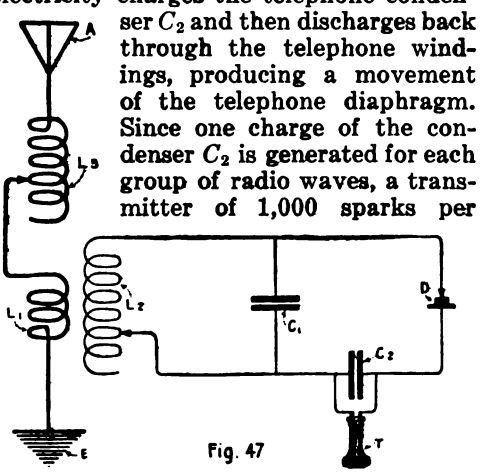

Fig. 47

A complete hookup for a wireless telegraph receiver with aerial circuit in two parts

second will produce, at the receiver, 1,000 pulses of current through the telephone in each second. If these pulses occur uniformly, the telephone diaphragm will make 1,000 regular movements per second and a musical tone of the pitch 1,000 will be heard when the telephone is held to the ear.

(To be continued)

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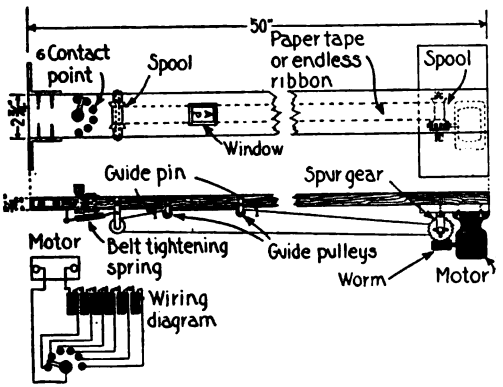
Telegraph Speed Practice with an Endless Ribbon

THE following scheme is one I recently designed to aid a young student of wireless telegraphy to work up speed in operating. It will adapt itself, however,



A motor-driven paper ribbon carrying characters for learning a code of any description

to a great variety of uses, such as learning a shorthand alphabet, a foreign-language vocabulary, typewriter keyboard, etc.

It consists of a wooden upright, in which is cut an opening just large enough to show one character at a time. On the back of this are four pins which serve to hold the moving ribbon in position, and two rollers to keep it close to the opening. The endless paper ribbon, on which the code is written or printed, is worm-driven by a small battery motor, over two wooden spools, one equipped with a spur gear, the other having a spring tension for the purpose of keeping the belt tight. A multipoint switch, which acts as a speed regulator, completes the apparatus.

The illustration gives the over-all dimensions rather than the specific ones, since the size of the device can readily be made to suit the individual requirements.—L. C. ARNOLD.

Save Hard Putty by Grinding and Making It Over

HARD putty can be made as good as new by simply putting it through a common household size food or meat grinder, using a fine cutter, and then mixing it with the proper proportion of oil to make it pliable.—E. M. THAYER.

Things to Know in Using a Hone and Strop to Sharpen Tools

AS a tool the razor will interest more men than any other tool known, not excepting the pocket knife. How to sharpen it is, therefore, a very vital matter. A good hone or stone is the first thing of importance. It must be neither too coarse and gritty nor too fine. It should have no flaws, though these are sometimes so minute that even an expert has difficulty in locating them. A good German stone is used by rubbing a smaller stone of the same kind on the face of the hone, with water, making a slight lather, on which the razor is worked, a few strokes usually being sufficient. As to quality, the stone costing the most will usually be the best.

Lay the razor perfectly flat on the stone diagonally, and draw the edge forward across the length of the stone. In nearly all cases of sharpening tools the edge is drawn or pushed forward, which prevents a wire edge as much as possible. Use a light pressure, reverse the razor with each stroke, turning it over on its back only. The condition and thickness of the razor will determine the number of strokes necessary, but in any case use as few as possible, stopping when you feel the smooth edge gone, though the edge should not feel wiry. The barber's rule is to use the hone little, but the strop more. The harm done by excessive honing can only be rectified by considerably more stropping than should be necessary. A stone may be used dry or with water or oil, as the stone may demand, the reason for using a liquid being to prevent the stone glazing.

The sharpening of safety razor blades is the same as the ordinary razor blade. To strop either form of blade hold it perfectly flat on the strop, holding the strap as rigidly as possible. Any slackness in the strop will cause the edge of the razor to become more or less bevelled. Draw the razor diagonally from heel to point, but never the reverse of this way. In the proper way the edge of the razor will not be drawn against its cutting edge, but away from it, the reverse of the honing operation. It is also important that the razor be drawn its full length with each stroke, from heel to toe. Strop

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lightly. The four-square and also some two-sided strops have a coarse side which will make a good edge in the absence of a good stone. In fact, it is best to use this unless the razor is very round of cutting edge; a few strokes is all that will be necessary.

The strop hone is used dry, hence it is handy when you wish to give your razor a touch on it, when it is getting smooth on its edge. A drop of some non-drying oil should be applied to the strop at intervals, to keep it in good condition.

The oil stone must always be kept oiled and moist on its used surface, for if allowed to become dry and glazed it will get hard and unfit for use. Most new razor stones are better after being soaked in oil for a few days. Stones are usually sold with wood covers, to protect the surface from dust and from drying out. When you have finished using the oil stone rub a little oil over its surface and place it in its box.

Be careful in using the stone so that its surface will wear evenly. Turn the stone end for end, occasionally, and keep it clean by wiping the surface off with a clean cotton rag or cotton waste. If the stone has worn unevenly, make it level again with a piece of sandstone or emery brick. If the stone has become glazed or gummed up with oil, clean it off with ammonia or benzine. Never use turpentine or any non-drying oil on the stone. Excellent oils may be bought that are especially adapted for the purpose, but any oil that is used for sewing machines, typewriters, etc., will do.

For sharpening a pocket knife one may buy a stone that is made for the purpose, one that has just the proper amount of grit, is medium of grain, and that cuts fast enough without producing a wire edge. In sharpening a pocket knife the back is held slightly up, and the blade is drawn with an oblique motion, back and forth, rather quickly. The edge of the blade is drawn against the stone, not with it. Select a stone having the right grain, and it will give the knife a good edge. If there should be any rough edge it may be removed by a few strokes on the razor strop.

To sharpen a sloyd knife, which has a bevel embracing about one-half its width, lay it flat on the stone, like a razor, but do one side of the blade at a time, using the right and left hand alternately.

Many people sharpen a tool by working it on the stone in a rotary fashion, and this is not a good plan, as it is more apt to produce a wire edge. When a chisel is done this way it will make an uneven cutting edge. In any case, such a plan will cause more trouble in getting a fine edge. When sharpening a tool on a stone it is commonly drawn against the edge, but on a leather strap this of course cannot be done, without danger of cutting the leather.

In grinding a chisel or plane-bit on the grindstone keep the tool's edge firmly in one position, not permitting it to wander about. The idea is to get a slightly concave surface near the cutting edge, on the principle of the concave razor. Such an edge is easier to keep sharp and to resharpen. The emery wheels or those of corundum are furnished with a rest, which makes it easier to keep the tool in one position. When sharpening the tool on an oil stone hold it at the right angle, and in a diagonal position, not square with the stone. Almost always a mechanic, when sharpening a chisel or plane bit on a stone, will hold it square with the stone. Hold the tool firmly with both hands, drawing it back and forth, still in the diagonal position, but horizontally. It is important to hold the tool right, in order to get a true cutting edge. Reverse the position of the stone occasionally, and use the full face of it. When it has been sufficiently sharpened, turn it over and rub it lightly on the stone, to remove the slight roughness.

Chisels are made with angles adapted for working various woods—a slanting angle for a soft wood chisel, and a sharper angle for one used in hard wood. For a single-iron jack plane the bit should be slightly rounded; for common jack planes a little less rounded, while for smoothing, panel and trying planes the bit should be square, but the corners should be slightly rounded off. For all other bits have them exactly square.

To sharpen a gouge bit and other tools having an irregular edge, slightly rock it sideways as you push it back and forth on the stone. When grinding on the grindstone hold the bit at right angles with the stone, rocking the bit as you

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grind it, in order that it may have a uniform bevel. Give the inside edge a few rubs with a round stone, to take away the wire edge.

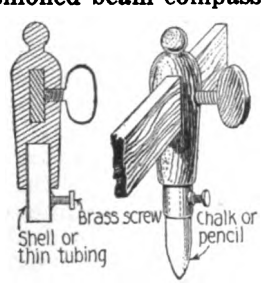
While most tools require to be ground with a smooth edge, the scythe and sickle demand the opposite—a rough, irregular edge; for a smooth edge would not catch and cut off the grass or grain. Thus the farmer pushes the stone away from him, over the edge of the blade. This gives the desired saw-tooth effect. When he sharpens the blade on the grindstone and starts cutting, he finds it necessary to give the edge a few strokes with his scythe stone, and then it cuts very much better.

The housewife sharpens her knife on an emery or corundum stick, usually by pushing the blade away from her. The right way is to draw the blade across the stick from heel to point, from end of stick to its heel, at a diagonal draw. It is not necessary to press very hard, as that injures the stick and does not make as good an edge on the knife. If a steel is used it should be a good one, or it will not sharpen the knife.

Shears and scissors should be left to the expert to grind. Sometimes a dull pair may be made to cut better for awhile by drawing the edges over one of the many devices sold for that purpose, but the result is seldom entirely satisfactory from any viewpoint.—A. ASHMUN KELLY.

Chalk Holder for Wood Workers' Beam Compasses

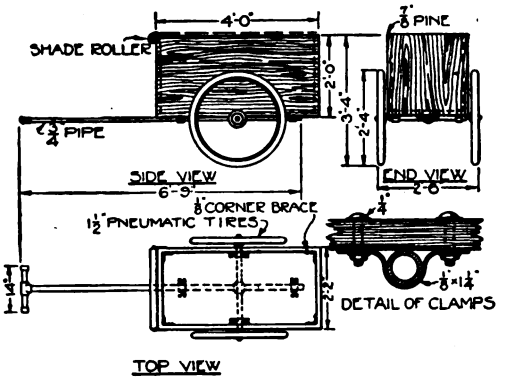
THE insertion of a brass rifle shell, sufficiently large to hold a piece of chalk, in an old-fashioned beam compass increases the efficiency of the instrument. A screw section from an old gas globe holder, soldered on, provides the fastening device. In this way pieces of colored chalk can be quickly inserted for different lines, and since chalk is used, it can be as quickly erased if a mistake is made. This obviates a deal of trouble for the amateur.



Converting a clothes-pin into a pencil holder

A Light Two-Wheeled Luggage Carrier for the Camper

FOR transporting your supplies from one camping place to another, or for a two-weeks' hike, a small two-wheeled, rubber-tired, weather-proof cart



A two-wheeled cart of light construction for carrying the camp duffle of a hunter

as shown, is very handy. The usual method of carrying a suit case filled with grub, cooking utensils, cartridges, moccasins, and all the other miscellaneous junk that campers are heir to, is entirely inadequate for the lone camper and sportsman, for he frequently finds a pleasant camping-ground and stays there a day or two, and then, when the spirit moves him, travels to another. The little hand car is a means of solving the problem.

The cart is constructed of two old bicycle wheels, iron pipe and a pine box for the body. The box is covered with a heavy window shade with its roller fastened to the front by the original hangers so that it may be drawn over the entire top and buttoned fast at the rear end to protect the contents against rain and dust. The tires should be kept inflated to a pressure of 40 or 45 lbs. and the axles well oiled.

On the outside of the body may be tacked or sewed several strips of leather belting, forming holsters for the hatchet, knife, lantern, etc. If the locality demands quick action, the gun or rifle may be carried where it can be snatched up in an instant. An old trunk strap slipped over the shoulder and handle makes an easy method of drawing the cart leaving the hands free to handle the gun when game is sighted.—P. P. AVERY.

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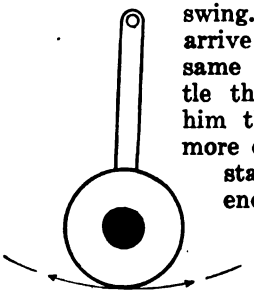
The Swinging Target Is Not Difficult to Hit

IT is a strange thing that the novice will almost invariably try to hit the bull's-eye of a swinging target when it is at the center or in the lowest position. The expert knows better. He knows that the time to shoot is at the end of the swing. In fact, anyone will arrive ultimately at the same conclusion, for a little thought will convince him that a target is the more easily hit when at a standstill, or at the end of a vibration. The moving target as a rule has the largest bull's-eye, and is often one of the easiest to strike, if you happen to know how.

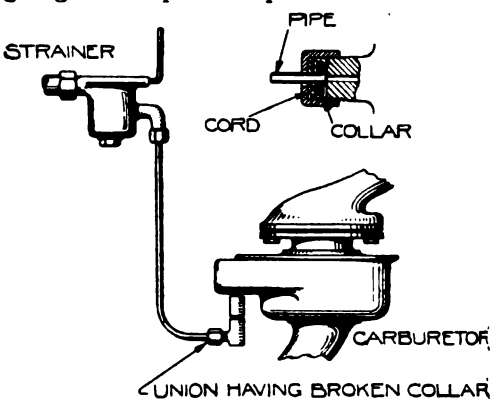


Don't aim at center of the swinging target

Simply aim at the point where the center of the target stops and wait till it returns. Then, bing! Your friend gives one of those sickly smiles and pays for the shots. Then he wastes another quarter trying to do something that he does not comprehend. "Simple if you only know how."—HAROLD C. RIDGELY.

Emergency Repair to a Broken Oil Pipe

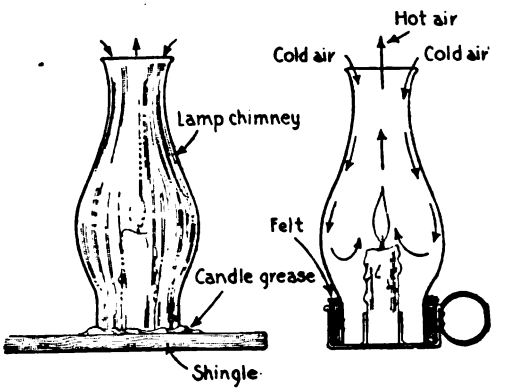
THE writer was recently out on a trip which ended several miles from any garage or repair shop. A flat bronze collar broke off the oil pipe next to the carbureter. The illustration shows how it was patched up to finish the trip. By means of a small punch found in the tool box, the pipe was flared to hold the collar, after which a few turns of light cord were wrapped behind it and drawn tight by means of the nut as it turned up. It afforded a perfectly tight joint and lasted until a new joint could be made in the shop, which could not be done until some days later.—F. W. BENTLEY, JR.



A modern method of joining a broken oil pipe to the carbureter of an automobile engine

A Simple Wind-Proof Lamp Used by Lumbermen

IN lumber camps a wind-proof candle-lamp is made by sticking the candle upright to a shingle with melted candle grease. A wind shield is made by placing a lamp-chimney over the candle as shown in the illustration and securing it air-tight to the shingle also by the melted candle grease. The supply of oxygen necessary to feed the candle flame is provided by currents of cold air which are drawn over the edge of the open top of the chimney and thence down, and close to the inner surface of the chimney to a point below the flame; the hot air from the flame passing upward and outward from the central parts of the open chimney top is protected from extinguishing wind currents, by the strong downward moving wall of cold air which rushes to replace the loss from combustion.



Two styles of a homemade lamp using the ordinary glass chimney with a candle

A practical embodiment of this principle is shown in the sectional view of the illustration, where the lamp-chimney base is supported within a cup-shaped candle-stick and the air seal is provided by an encircling band of felt. The novel principles of combustion and air replenishing currents are illustrated by arrows.

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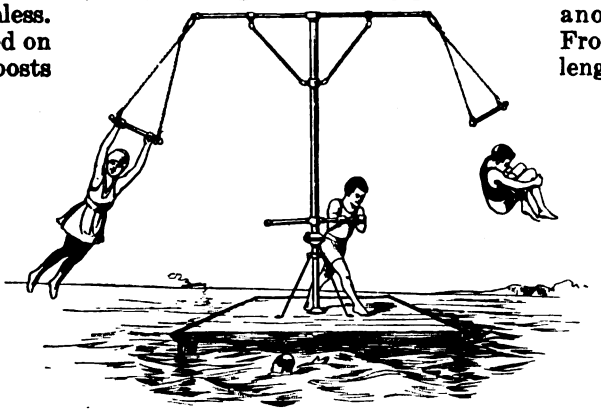
Centrifugal Whirler Offers a New Water Sport

A new, interesting sport at the seashore or lakeside always attracts the crowd. The "whirler" here described offers a distinct novelty in water sports, is comparatively easy to build, and, although a thriller, is harmless. It can be mounted on a raft or on posts driven into the ocean bed; in fact anything can be used for a support as long as the support is completely surrounded by water.



One active whirler furnishes the motive power while other participants in the game ride and dive

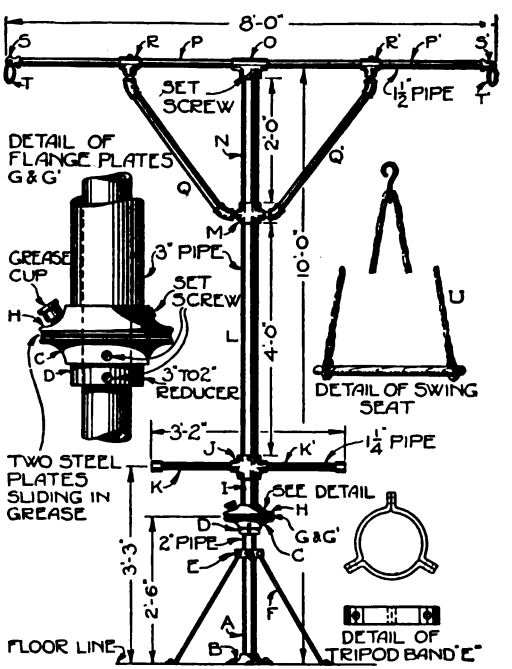
The main standard *A* is a 10-ft. length of 2-in. galvanized iron piping. This is firmly seated in a floor flange at the base, *B*. Another flange, *C*, with the face uppermost, is secured to *A* 2½ ft. from the floor. This flange should be for a 3-in. pipe and threaded to a short nipple, *D*, the whole of which is then slipped over *A* and held by means of set screws at the height mentioned.

The standard is supported in a vertical position by a tripod made of a band, *E*, and three legs, *F*. The band is made up of three separate strips of strap-iron; each with two lugs. These six lugs meet and form a circular band which fits snugly about *A*. The lugs are drilled to receive the three legs of round iron which are bolted in place; the other ends are bolted to the floor or platform.

The revolving spindle, *L*, is built up from the bottom as follows:

Have two polished steel plates or disks made with an inside diameter of 2½ in. and the outside diameter the same as the flange *C*. Slip these down upon *C* and then lay a corresponding flange, *H*, face down upon them. Fill the space between them with heavy grease which can always be replenished by a grease cup as shown. A nipple, *I*, of 3-in. pipe 6 in. long is then threaded into the flange, *H*, the top end supporting a four-way cross, *J*. Arrange to have the two side openings of the cross to take 1-in. pipe or otherwise reduce them to that size. These are to accommodate the handles *K* and *K'* made of 1½-ft. lengths of 1-in. pipe and capped at one end.

The main part *L* is a 4½-ft. length of 3-in. pipe thread—in the top of *J* to another cross *M*. From *M* rises a 2-ft. length of 3-in. pipe, *N*, to the tee, *O*. The total height of this revolving column may vary according to the depth that the sections are threaded together, but should be arranged so that the top of the tee, *O*, will clear the top of the inside standard *A* and the two flanges *C* and *H* will bear the complete weight of the column. The



Details of the parts for making the whirler to set on a float or dock at the beach

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horizontal arms P and P' are 4-ft. lengths of 1½-in. piping. The outer ends are fitted with a cap and eye—S and S'. These are supported rigidly by means of the two braces Q and Q' connected to M by a 45 deg. el and nipple. The opposite ends are threaded to a tee in the same manner, which is large enough to act as a sliding sleeve over the arms. The top of each tee, R and R', is tapped and fitted with a set screw to facilitate setting when the proper adjustment is found. Iron rings I and I' are passed through the eyes in the end caps S and S' and serve to hold the swinging seats U.

These swinging seats are a simple round wooden bar suspended from ropes as shown. They can be made adjustable in length by means of a buckle if desired. The average length should be enough to allow their being swung clear of the floor so they will not strike any obstructions.

When the bars, K K', are turned rapidly the occupants of the seats are swung outward in proportion to the speed of the arms by centrifugal force.

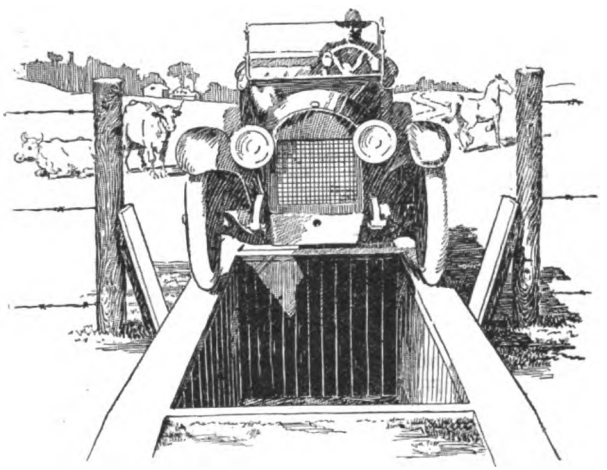
Spectacular jumps and dives into the water can be made according to the efficiency of the "crew."

A Heat Test That Shows the Quality of Wrought Iron

EVERY person who uses wrought iron for important parts of machines likes to know the quality of the metal he is using. By the simple test given in this article any workman can tell whether he is using first-class metal. Heat the bar to a cherry-red and plunge it into water heated to 82 deg. F. The bar is then bent cold around another bar of twice its own diameter or thickness. Good metal will not show any cracks or fissures at any point.

A Fence Stock Guard for an Automobile Road

IN a western community where a great many horses are raised there are many gates to open when traveling from place to place. When touring in an automobile, it was necessary to get out to open a gate and close it after passing through. As this took a great deal of time the owners of ranches built a guard, as shown in the illustration, to do away with the gates. The guard consists of a hole 4 ft. deep in the fence and two boards at the edge for the automobile wheels. The stock cannot pass through the opening and the automobile can be driven through without stopping to open and close the gates.—PAUL E. THOMAS.



A pit edged with boards for tracks in the opening of a fence for a stock guard and automobile gate

A Signal Light Connection for a Telephone Receiver

ON several occasions when an executive's assistant desired to converse with his superior the former was busy on the telephone, so he had to wait. To open the door every few minutes for the purpose of looking in or to have the operator notify you when the receiver has been hung up is both annoying and time-consuming. A private concern has installed an inexpensive device which eliminates this embarrassment. The executive's telephone has an extra connection which automatically lights a small blue light at the assistant's office when the former is using his phone. As soon as the executive hangs up the receiver the light goes out and the assistant knows that his superior is accessible. This device, which is very inexpensive, consists of two plates connected with wires which run through the cord to the assistant's office.

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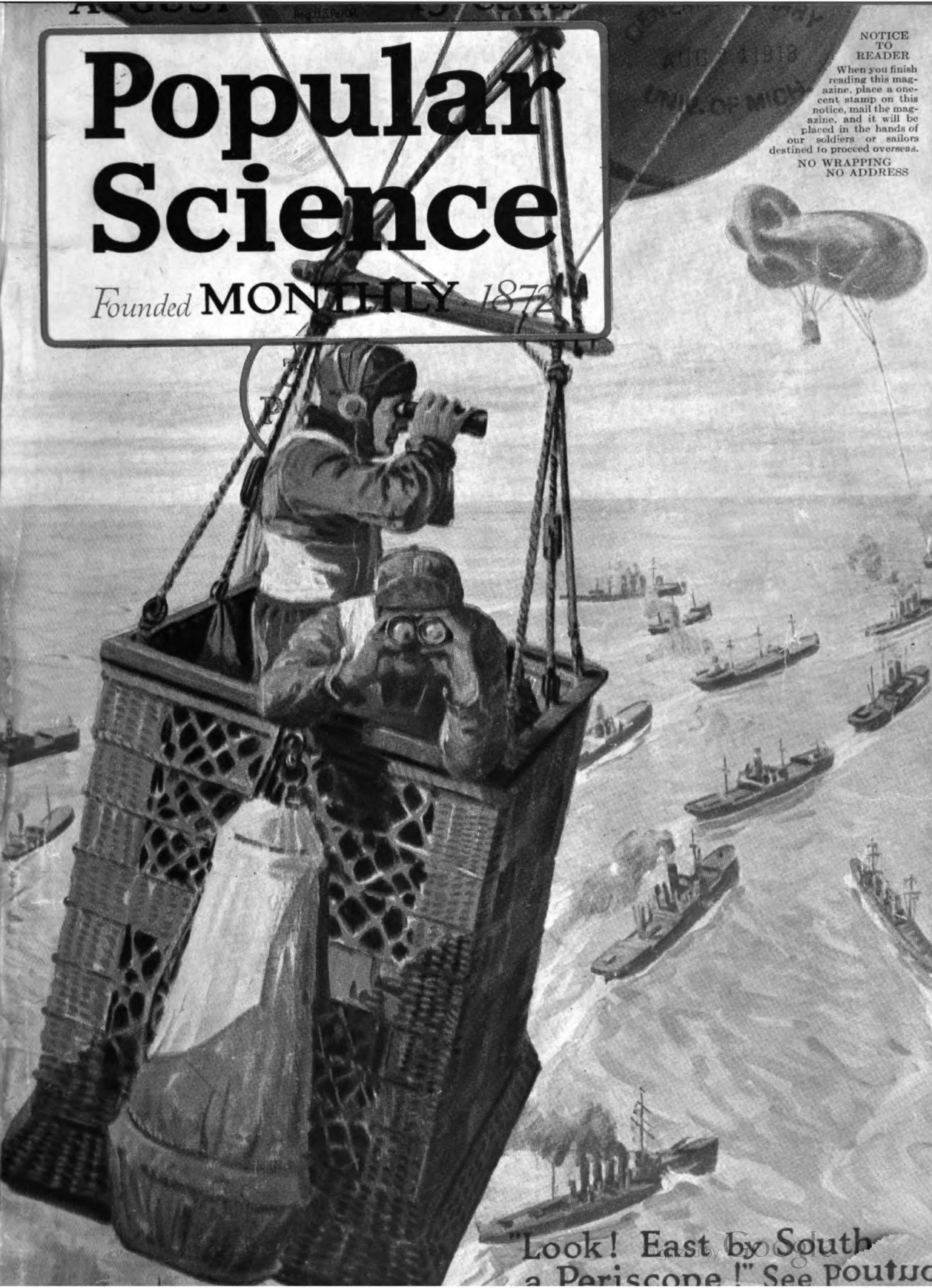

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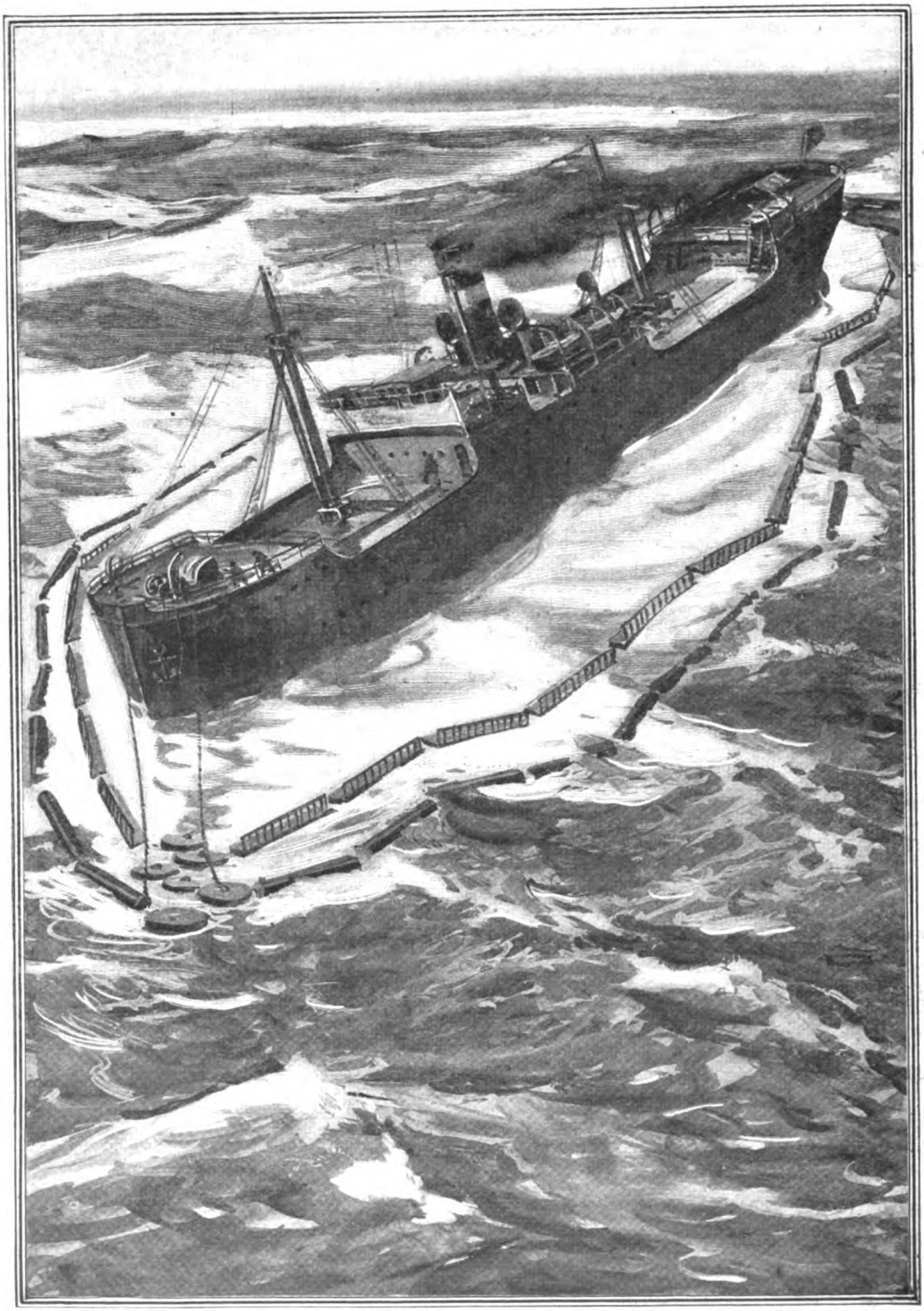
Saved by a Pool of Oil



A ship which has run aground in a heavy sea may be saved if you surround it with a floating breakwater and cover the water inside of the barrier with a film of lubricating oil

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Popular Science Monthly
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Pour Oil on the Troubled Waters

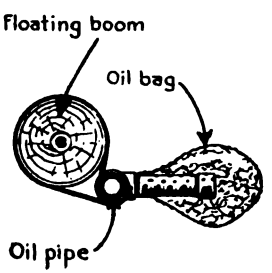
How to make a zone of smooth water around a stranded ship by means of a floating breakwater

A VESSEL, homeward bound and heavily loaded with a valuable cargo, misses the channel near the harbor entrance in the fog and runs aground. Perhaps she is merely stuck on a sand bar and can be towed free at the next high tide. More likely, however, she has struck a submerged rock, has sprung a leak and is gradually settling.

If the weather is calm and the sea not too rough there is a reasonable chance of saving vessel and cargo. But, will the weather remain calm long enough to make the salvaging of the ship possible? Even a moderate rise in the wind or a mere change in its direction may cause the waves to dash against the moribund craft and pound her to pieces.

Comparatively few stranded ships are ever saved from destruction. In many cases, where the conditions are unfavorable, even the crew is saved with difficulty. In such cases ship and cargo usually become a total loss.

The salvaging of stranded ships has been given considerable thought by inventors, but they directed their efforts principally upon methods of establishing communication with such ships and upon means for saving the lives of passengers and crew. Recently, however, an American, Jonathan Begg, of Oakland, Calif., has approached the subject from a different angle. In his invention, which was patented a short time ago, he seeks to prevent the destruction of the ship by surrounding her with a protective zone of smooth water.



Pouring oil upon the troubled waters does the trick every time

The theory of Mr. Begg's invention is unimpeachable. The efficacy of breakwaters is based on well understood principles and so is the effect of pouring oil upon troubled waters. The inventor has relied upon the protective power of these two agents to produce around a stranded ship a zone of safety. He proposes to surround the stranded ship with a floating breakwater and to cover the water between the ship and the breakwater with oil. He expects, thereby, to produce around the ship an area of comparatively still water, sufficiently large to prevent the heavy sea outside of the breakwater from reaching and destroying the ship.

Around the ship, at a reasonable distance is placed a barrier of logs or cylinders of copper or aluminum netting filled with cork. These logs are to be strung on a cable and anchored by cone-shaped weight anchors with claws or prongs which are supposed to take a firm hold in the bottom of the sea. To the logs pipes connected by flexible joints and provided with nozzles are attached. This ring of pipes is connected with the ship by a supply pipe through which oil is conducted to them. Between that outer ring of logs with their attached oil-distributing pipes and the ship the inventor places another protective ring, consisting of frames so weighted, that they float in an upright position. These frames are attached to logs strung upon a cable and are flexibly joined together by heavy copper netting. This inner breakwater also is anchored in position.

Theoretically this double

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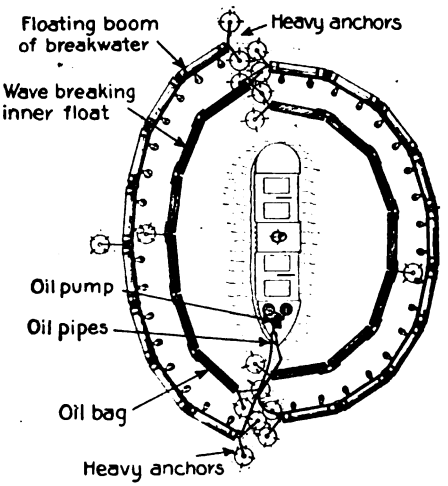
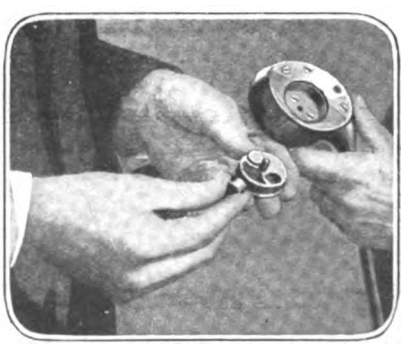
breakwater should be efficient provided certain conditions are fulfilled. There are a great many "ifs." The area inclosed in the breakwater must be very large to produce any quieting effect upon the breakers. The breakwater must be securely anchored, otherwise it will be dashed against the ship and wreck it. But, even if we accept the theoretical possibility of the inventor's plan, its practicability seems extremely doubtful. It would require a great many logs to enclose an area sufficiently large to do any good and the ship would have to carry these logs, pipes and frames stowed away on the deck. They could not be placed in the hold because, like lifeboats, they are intended for an emergency which permits no delay. Another difficulty would be the launching of the breakwater in a storm.



Two concentric breakwaters produce a safety zone of smooth water around the ship if the angry billows permit

The Brassie Too Heavy? Then Take Out Some Weights

WHEN the golfer finds his ball in a good "lie," too far away from the hole flag for an iron shot and yet at such a distance that he fears he will overdrive by using the brassie—then is the time he should congratulate himself on having obtained a brassie with a device for lightening the club. This device is a container attached to the head of the club with space enough for weights. By removing a screw the container can be removed from the club and the weight or weights taken out, thereby reducing the force with which the club strikes the ball and enabling him to attain his object.



A brassie that's heavy or light as weights are inserted or removed from the container in the club's head

The Importance of Snugly Fitting Piston Rings

WHILE the soul of an automobile is naturally its engine—the vital spark that keeps it going—the piston rings are its heart and lungs. If the cylinder is not absolutely air-tight, it is faulty and fails to develop to the utmost the power furnished it. Piston rings are designed to make the cylinder air-tight, and their important function is thus explained.

When gasoline explodes in a leaking cylinder, a certain amount of its explosive power is wasted, whereas in an air-tight cylinder the entire force of the explosion is utilized.

The exploding gases in a cylinder develop an intense heat—about three thousand degrees of Fahrenheit. If the piston rings are not capable of responding to the expansion and contraction that result from such repeated influences of great heat, they will soon be incapable of giving good service. A ring made in one piece is most likely to have the proper qualities, if made of well-tempered material, hammered on the inside to give it greater strength and resiliency.

Since the cylinder is round, it stands to reason that the piston ring ought to be round also. If it is not, it is like the square peg in a round hole.

The motor that works only indifferently well with ill-fitting piston rings may work to perfection with rings that are accurately fitted. Concentric rings insure uniform pressure to all points and utilize to the full the explosive charge of the fuel-gas.

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A Sure Enough Mowing Machine for the Hair

"NEXT!" The hirsute backwoods man, who had been dozing in one of the chairs over the dilapidated pages of a pinkish periodical, arouses himself, walks over to the just vacated barber-chair and with a yawn settles down for another snooze.

"Haircut and shave!" is his laconic order to the barber.

Giuseppe languidly rolls a little stand to the chair, grasps a mysterious instrument connected with the stand by a flexible tube and turns a switch. A humming sound is heard, which seems to come from the instrument in the barber's hand.

The man in the chair, who had been watching the barber's doings with growing suspicion, is now fully aroused.

"Not much!" he says, as Giuseppe approaches him with the mysterious instrument. "I don't want to be electrocuted or have holes drilled in me!"

It took some lengthy explanation to convince the suspicious backwoodsman that the barber had no designs upon his life, but merely wanted to cut his hair with one of the new-fangled rotary cutters.

The tool shown in the accompanying illustration is the invention of Manfred Petrella, of Buffalo, N. Y. It consists of spirally curved pivoted blades revolved in a conical casing. The principle of the device is precisely that of the familiar lawn-mower. A movable guard permits adjustment of the distance between the cutter and the skin and a receptacle is provided to catch the hair as it is cut off by the revolving knives.

Yes, you can cut hair like grass now with this machine

You wind in and out on the famous Chimbatti loop of the narrow-gage railroad to the mountain resort of Darjeeling, in India

Cork-Screwing Up the Himalayas to Darjeeling

ONE of the most interesting railroad lines, the construction of which meant the solution of difficult engineering problems, is the narrow-gage railway which winds its way up the steep slopes of the Darjeeling range of the Himalayas to Darjeeling.

Darjeeling is a noted health resort of the British rulers of India and the summer seat of the Bengal Government. It is 7,400 feet above sea level. Its delightful climate and the magnificent scenery surrounding it, including a panorama of the highest peaks of the Himalayas, make it one of the most desirable places in India during the hot season. One of the remarkable features of the mountain railway is the Chimbatti loop, probably the only example of its kind in the world. The tracks, rising at a steep grade, make a complete double loop to reach the station on the mountain top.

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With meat soaring to prices that only a Rockefeller can pay, who knows but we may be eating seaweed soon?

Learn to Like Seaweed. It May Become a Popular Food

ROCKWEED soup, rockweed omelet and rockweed pie may soon be found on the table of the housewife who is alert to obtain nutritious and inexpensive food. A considerable variety of edible seaweeds, of which rockweed is one, can be found along both the Atlantic and Pacific coasts of this country. Japan has been awake for some time to the value of seaweed as a food and the United States is now beginning to realize its worth. In Maine rockweed is being gathered in large quantities and prepared for market.

Peanut Flour as a Wheat Substitute

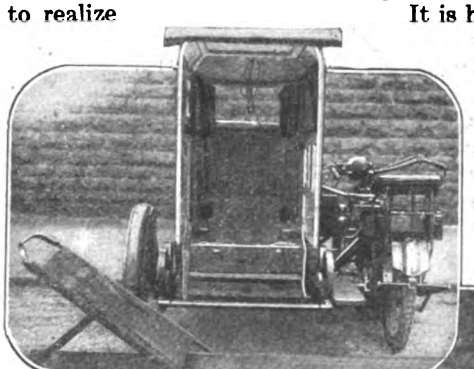
A BAKING company in Gainesville, Fla., has put bread in the market which is made from peanut flour. The flour is made from peanut cake left after the extraction of the oil. It contains a satisfactory percentage of fat and is said to have almost twice the nitrogenous food value of dried beef.

Chauffeur and Nurse, Too, Is the Ambulance Driver

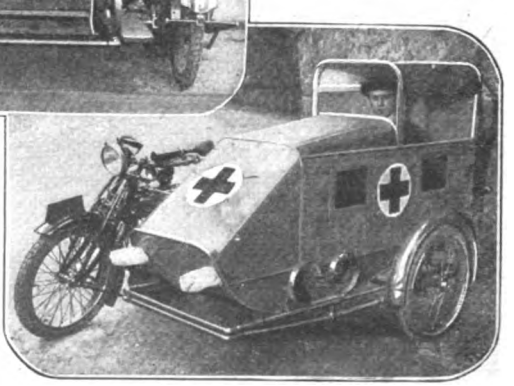
THE French Government has adopted for the use of the army a sidecar ambulance, which, in many respects, is superior to the other types heretofore used. It is built of light material and is large enough to accommodate but one stretcher. Windows with removable curtains are provided to enable the patient to look out while lying on the cot or stretcher. The cot can also be so arranged that the patient may sit up. An electric bell connects him with the driver of the motorcycle, who also acts as nurse.

One considerable advantage of this type of ambulance is that patients may be transported in it while sitting or reclining and that they can obtain not only all the sunlight and fresh air they desire, but also an unobstructed view of the country through which they pass on their way to the rear. No extra attendant is necessary except in cases where the patient needs close attention.

It is hardly practicable to employ one ambulance driver for one wounded man, as a rule. Hence it may be assumed that the vehicle is used only for exceptional cases.



It is just wide enough for a wounded man



The wounded soldier can sit up if he likes

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The Bacterial Inhabitants of Ice-Cream

THE population of the United States is approximately one hundred millions; the bacterial population of one cubic centimeter of ice-cream is 37,859,-909, or about six hundred and six millions to a cubic inch. That makes quite a crowd of bacteria in a glass of ice-cream soda. But don't be afraid of your ice-cream on that account, for most of those bacteria are harmless, and many of them are actually helpful, enriching the gastric juice by adding to its digestive properties.

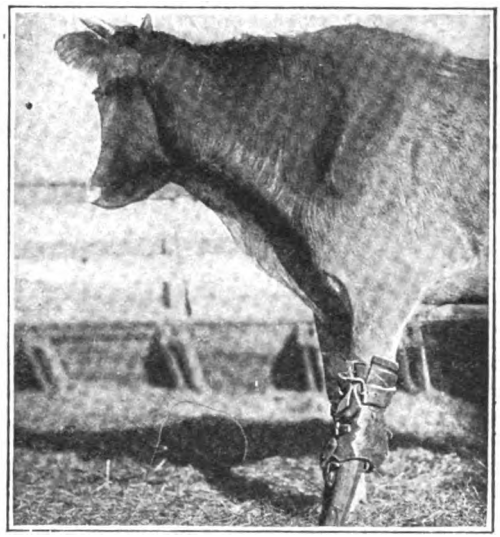
A Ducking Goes with an Automobile Ride in This Park

AUTOMOBILISTS who visit Rock Creek Park in Washington, D. C., find it necessary to ride through the creek after which the park was named instead of over it. This is due to the fact that the engineers in laying out the park were careful to preserve, as far as possible, all of the natural beauties of the place. Therefore they decided, instead of constructing bridges across the creek, to build fords, which were more picturesque as well as more economical.

That part of the road-bed which runs through the creek is built of cement. It is wide enough for two machines to pass, its boundaries being indicated by rows of boulders which project above the water. When the cars pass through the creek at good speed the water is thrown up in wall-like formations and the occupants of the automobiles receive a wetting. However, if the machines maintain a speed of about four miles an hour the involuntary ducking can be toned down or avoided.

© Publisher's Photo Service

They are running in water, and yet they are on a road—a cement road under water which constitutes a ford



When a cow or a horse breaks a leg the farmer usually grabs his gun. But what's the matter with wooden legs?

Here's a Cow That Walks About Despite a Wooden Leg

THAT a broken leg need not be a handicap to the bovine species has been demonstrated by a valuable cow which was found on the ranch of A. C. Chafin, near the town of Temple, in Texas. A corn-planting machine was the means of accidentally breaking one of her legs and her owner substituted therefor a wooden member. It fits so well that she walks about with the same ease that she possessed before the accident occurred.

This successful surgical operation will no doubt suggest to other farmers the feasibility of saving their cattle when they are similarly injured.

This cow's milk is as good as ever in spite of her accident and her artificial but serviceable leg.

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Training Intelligent Dogs to Lead Blinded Soldiers

The dog has two collars, each with a leash, and one having blunt spikes on its inner surface which arrest the dog's attention sharply but do not injure him

Teaching the dog to avoid leading the blind man between two objects too close together to permit the man to pass through with ease

Leading his master through a group of bottles. Major Mairic of the French Army is the originator of this method of teaching man's faithful friend to be a help to blinded soldiers

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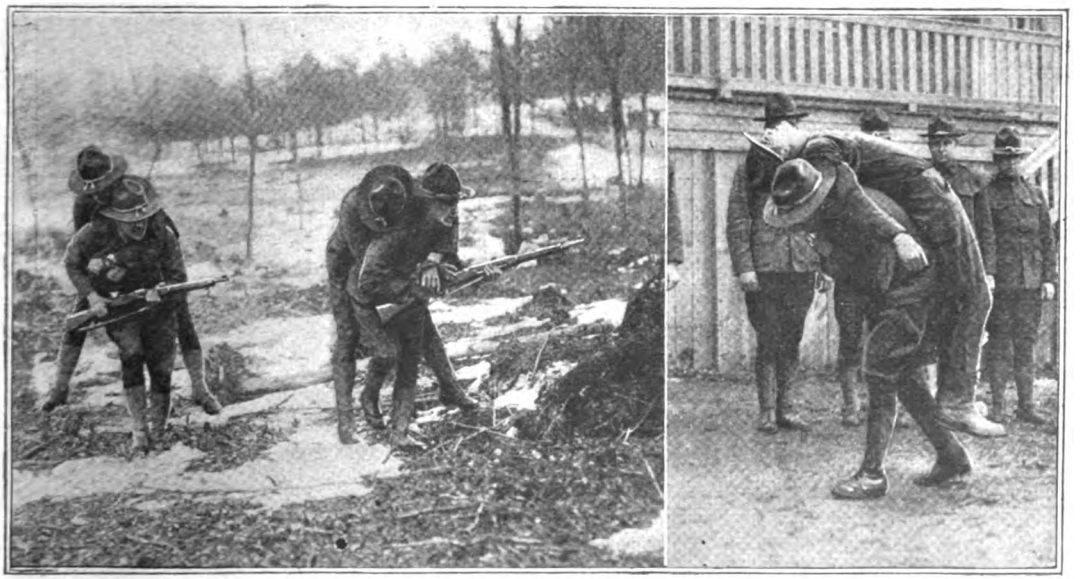
How Injured Soldiers Are Carried

The wounded comrade is carefully lowered to a sitting position, his armpit catching on the knee of his carrier who can then change the position of his own arm and legs in lowering the wounded man to the ground

Reaching through with his left hand, the rescuer pulls up the free leg of the injured man, most of the weight then resting on his neck

© Photos by American Red Cross

Effective carrying position, also employed by firemen. The problem is to put down the patient on the ground at the dressing station



The only way for a soldier to carry a wounded man and still have his hands free to fight is shown above

The injured man is slung over the shoulder and held by his coat tail

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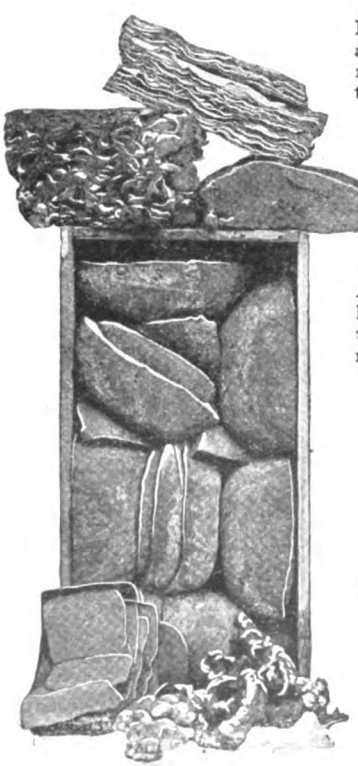
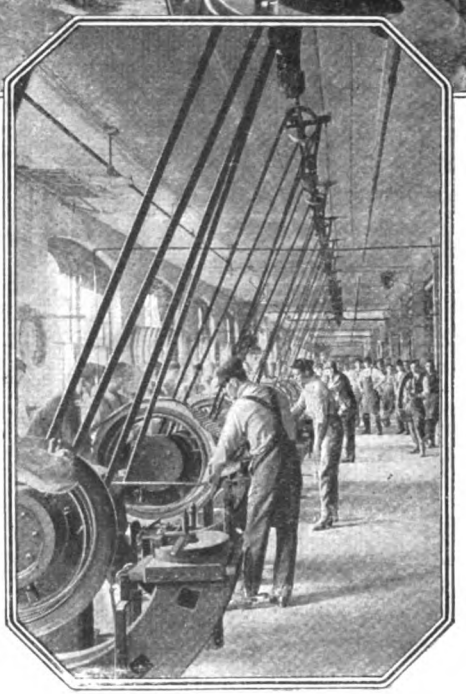
Your Automobile Tires Are More Costly Now

We ride on air imprisoned in a rubber tube which is strengthened with threads of cotton



Rubber "biscuits" are the raw material as it reaches the manufacturer



A good tire must have a good tread—the surface which rolls on the ground

	SERVICE	TIRE	PER MILE
1917	8000 mi.	$ 36.45	4 5/100 ¢
1916	6000 mi.	27.00	4 5/100 ¢
1915	4500-5000 mi.	23.80	4 8/100 ¢
1914	4000-4500 mi.	28.50	6 5/100 ¢
1913	3500-4000 mi.	34.30	1¢

Though the cost of tires is greater than in 1913, it is offset by the increased mileage

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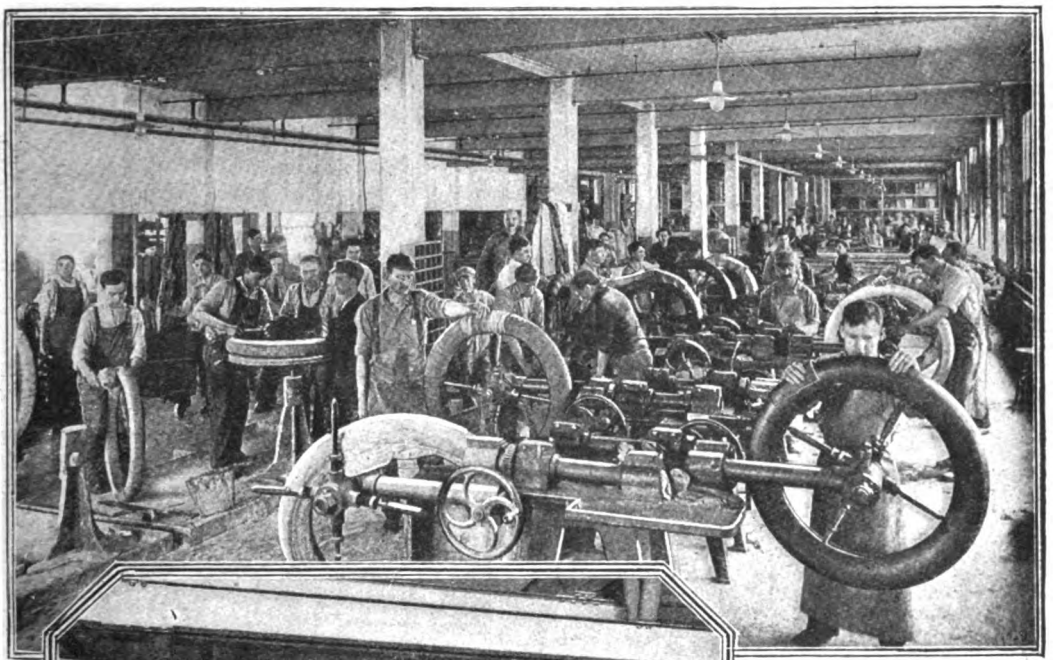
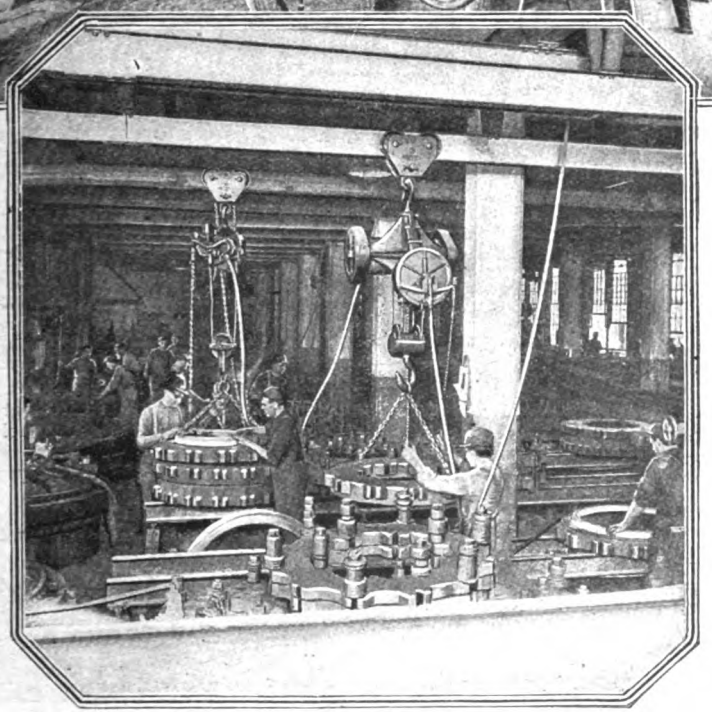
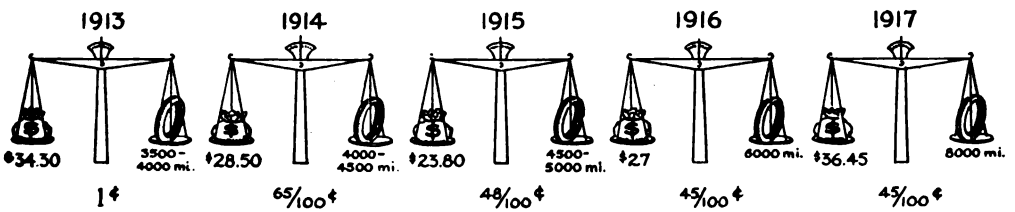
But They Are Giving You Greater Service



Cotton fabric is the one material without a substitute for building the framework of the tire. Tire cost per mile is kept down by a good fabric



Vulcanization—applying heat under pressure—gives the tire strength and serviceability. The sulphur chemically reacts with the rubber, making a resilient substance



During the last five years, the gradual increase in the cost of tire production has been nearly balanced by greater tire efficiency, so that cost per mile is still under one cent

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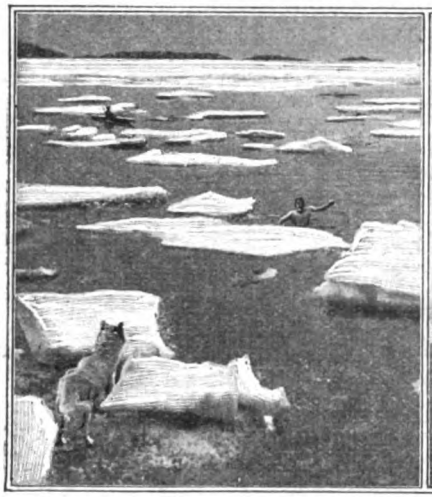
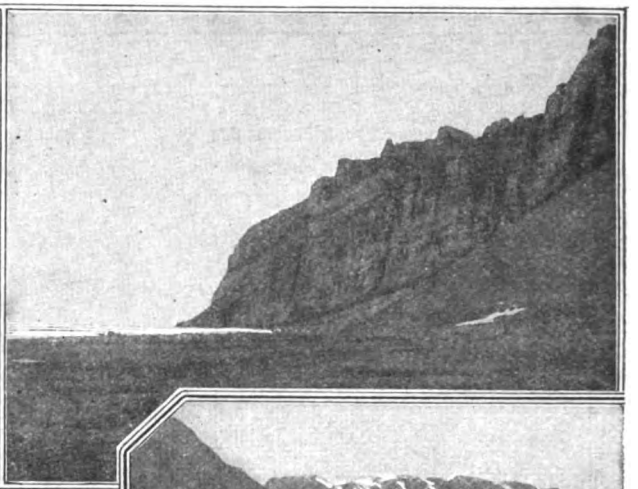
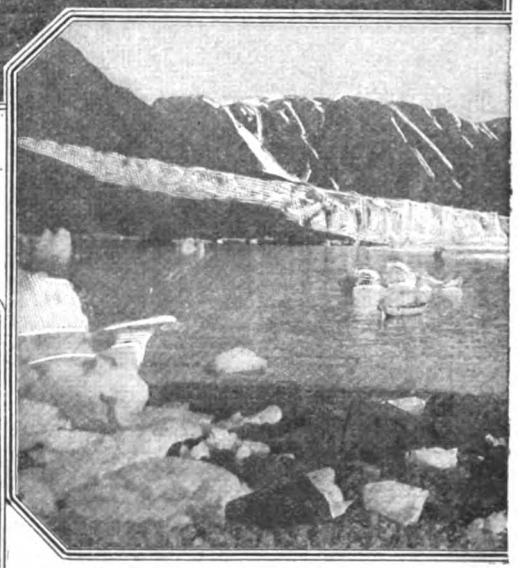
Among Greenland's Icy Mountains the Birds



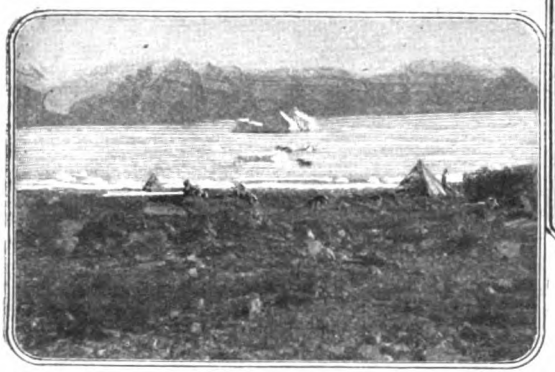
No wonder the dog is looking with some astonishment at a man bathing in icy water. This really happened near Etah, Greenland



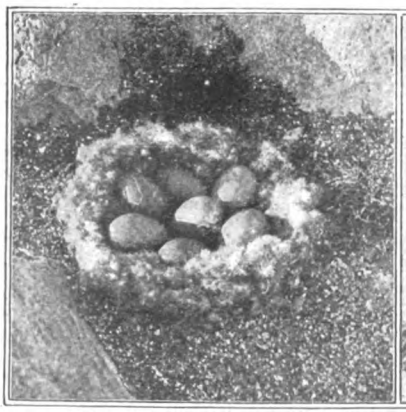
Where countless birds nest among the cliffs at Okrah, northwest Greenland, during the hot summer months



When you see an iceberg in the Atlantic Ocean, the chances are that it broke off from a Greenland glacier.



MacMillan and his expedition camped on the shore of a deep inlet on the northwestern coast of Greenland. See the tent on the right



The eider duck uses her down to make a comforter for her eggs

Etah is the place we have selected for the Popular Science Monthly's summer office. It is in northwestern Greenland

© Photos by D. B. MacMillan, Leader of Crocker Land Expedition. Courtesy of American Museum of Natural History

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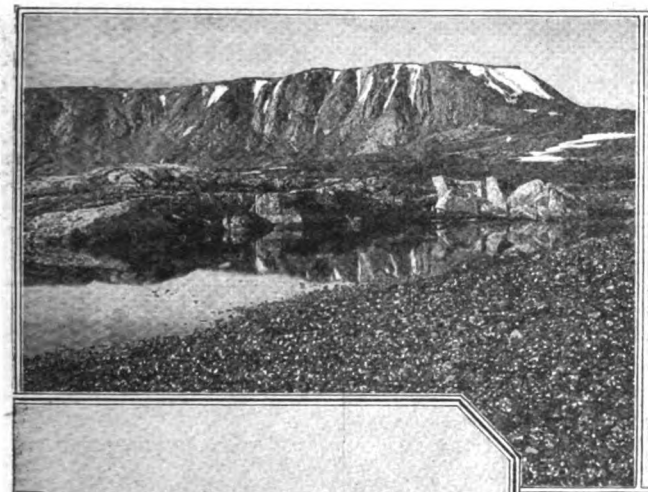
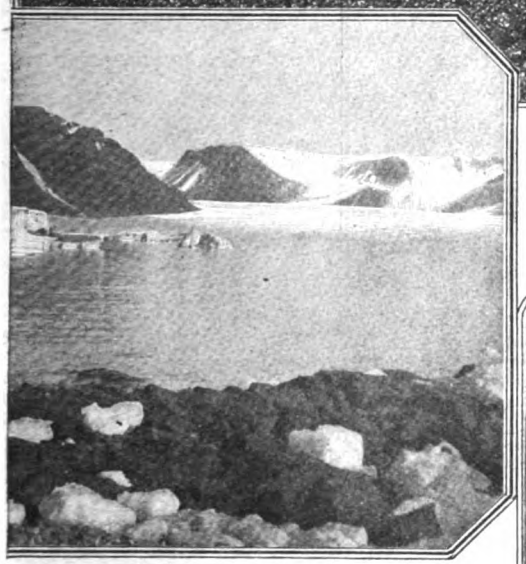
Twitter and Flowers Bloom in Summer



No wonder they call this Surprise Point. Millions of poppies bloom here in summer. See foreground of picture above

This cairn was built by Peary at Camp Thomas Hubbard many years ago. Ensign Green is standing beside it



This particular mass of ice is called Sonntag Glacier in northwest Greenland

After three years the MacMillan Expedition still had 30,000 pounds of biscuits left. Mr. **Hoover ought to send his congratulations**

MacMillan had all the excitement of an Arctic picnic though he went for the purpose of exploring an unknown land

Greenland is not all ice and snow. These flowers prove the contrary

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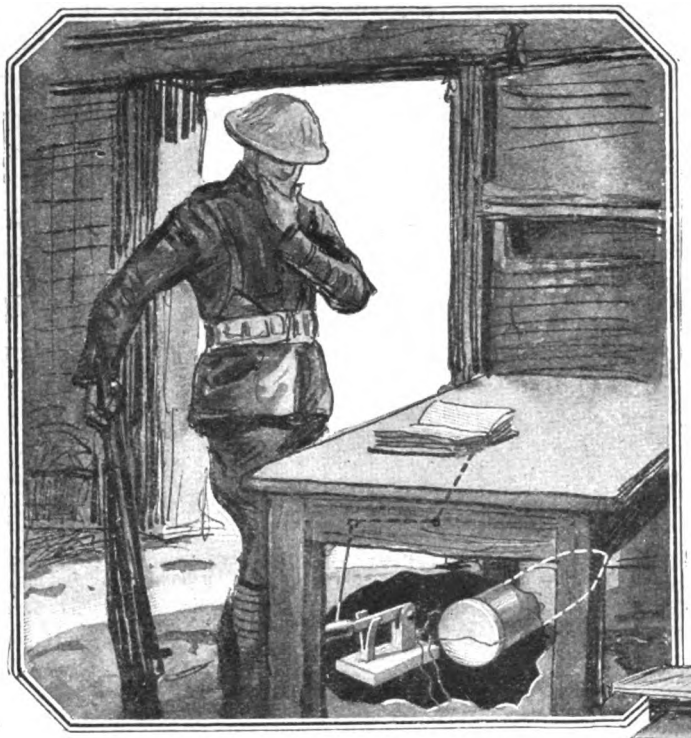
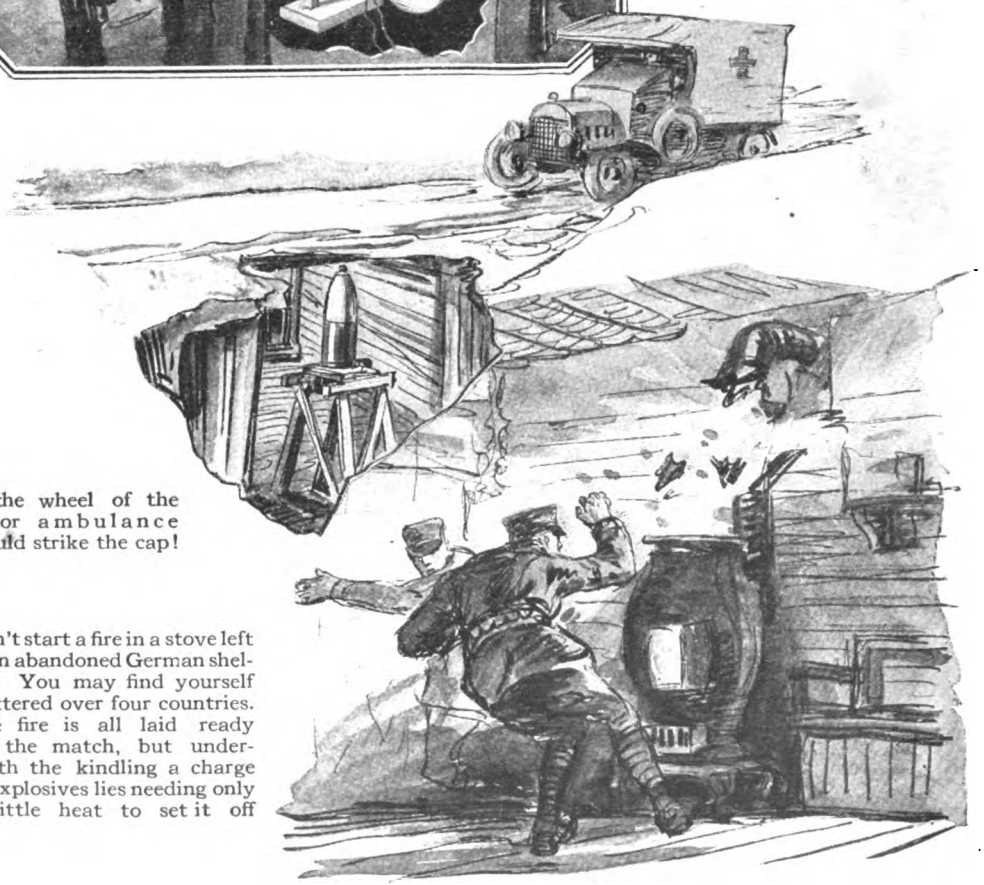
Camouflaging Death. The German Lure



Shall he lift the book or shall he not? No wonder he lays a doubting hand on his chin. If he has not been warned to be on the lookout, or if he lets his curiosity get the better of caution there will be another casualty to report. Cunningly concealed wires lead from the innocent looking volume to a death-dealing explosive



If the wheel of the motor ambulance should strike the cap!

Don't start a fire in a stove left in an abandoned German shelter. You may find yourself scattered over four countries. The fire is all laid ready for the match, but underneath the kindling a charge of explosives lies needing only a little heat to set it off

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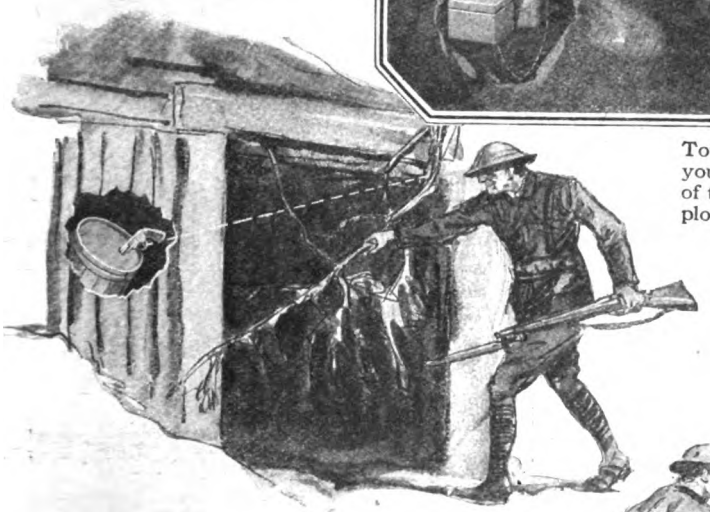
to Suicide Left for the Unwary

Eternal vigilance is the price of safety when our men move into towns or trenches abandoned by the Hun, To pick up a helmet for a souvenir is to invite death; if a board offers a most convenient bridge across a ditch it is probably a death trap, and the grandfather's clock in an old farm house may be the timing device for an infernal machine. Our soldiers have been schooled to detect and avoid these devices

Touch that shovel, Bill, and you die. The spring members of the clip will meet and the explosive will be electrically ignited



That artfully drooping tree branch—touch it not. The trigger of a loaded pistol will be pulled if you do, and a keg of explosives will be set off. This was one of the first devices adopted by the Germans when they introduced the art of the camouflage of death

Look out for the house that has miraculously escaped destruction. If you walk up the steps, you are sure to touch a concealed cartridge cap and go higher than you wish

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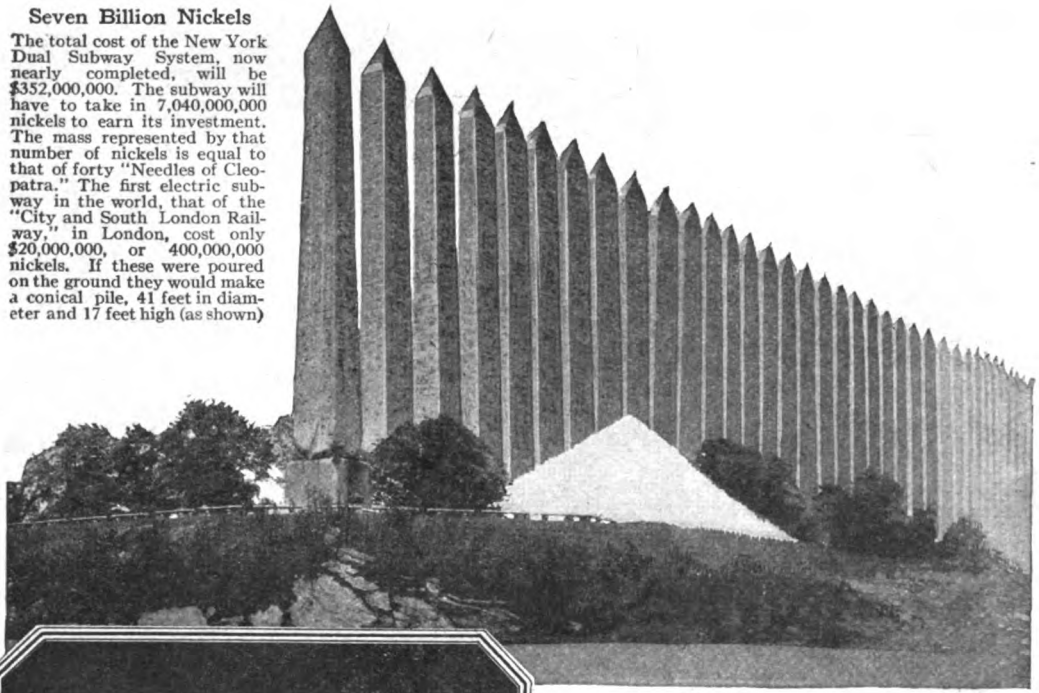
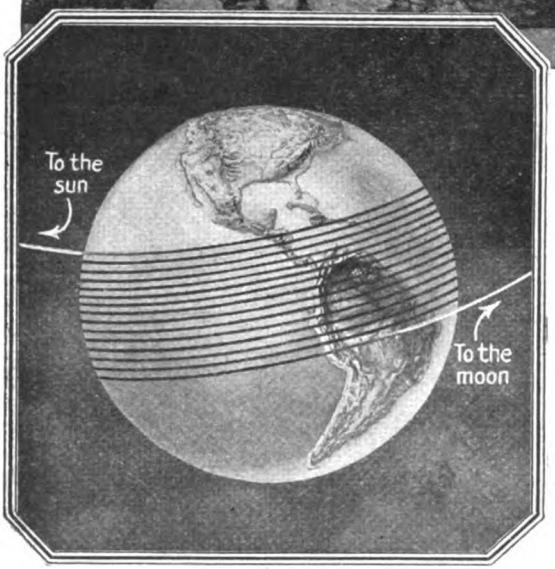
Seven Billion Nickels

The total cost of the New York Dual Subway System, now nearly completed, will be $352,000,000. The subway will have to take in 7,040,000,000 nickels to earn its investment. The mass represented by that number of nickels is equal to that of forty "Needles of Cleopatra." The first electric subway in the world, that of the "City and South London Railway," in London, cost only $20,000,000, or 400,000,000 nickels. If these were poured on the ground they would make a conical pile, 41 feet in diameter and 17 feet high (as shown)

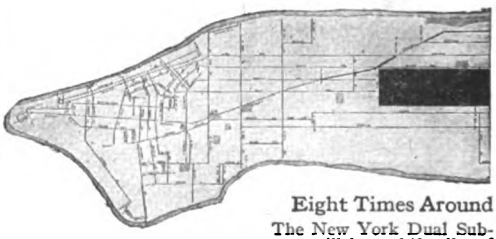


These Stupendous of New York City's



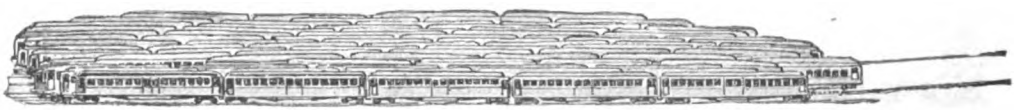
More Bewildering Figures

The trains of the New York Subway make a total of 109,500,000 miles in a year. A track of that length would go fourteen times around the earth, then to the sun and six times around the sun. The total mileage of the trains of the London Subway is only 589,401 miles in a year. That would be equal to the distance to the moon and fourteen times around the earth



Eight Times Around

The New York Dual Subway will have 260 miles of single track. A track of that length could be wound around Manhattan Island eight times. The City and



The total amount of energy expended by the New York Subway System since its opening, October 27, 1904, would

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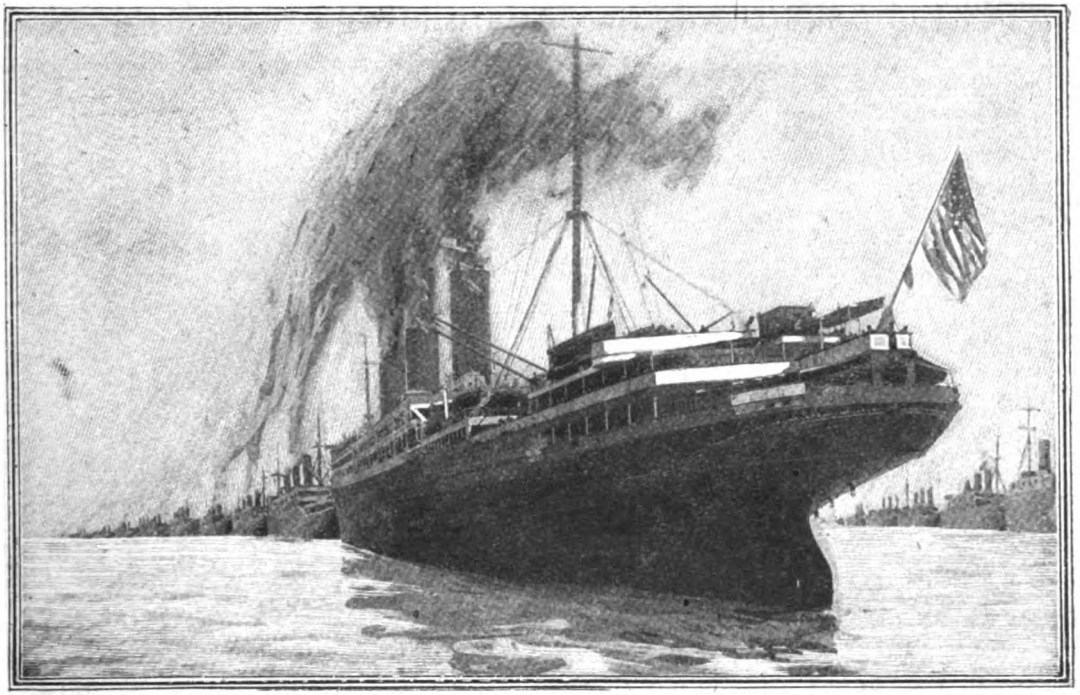
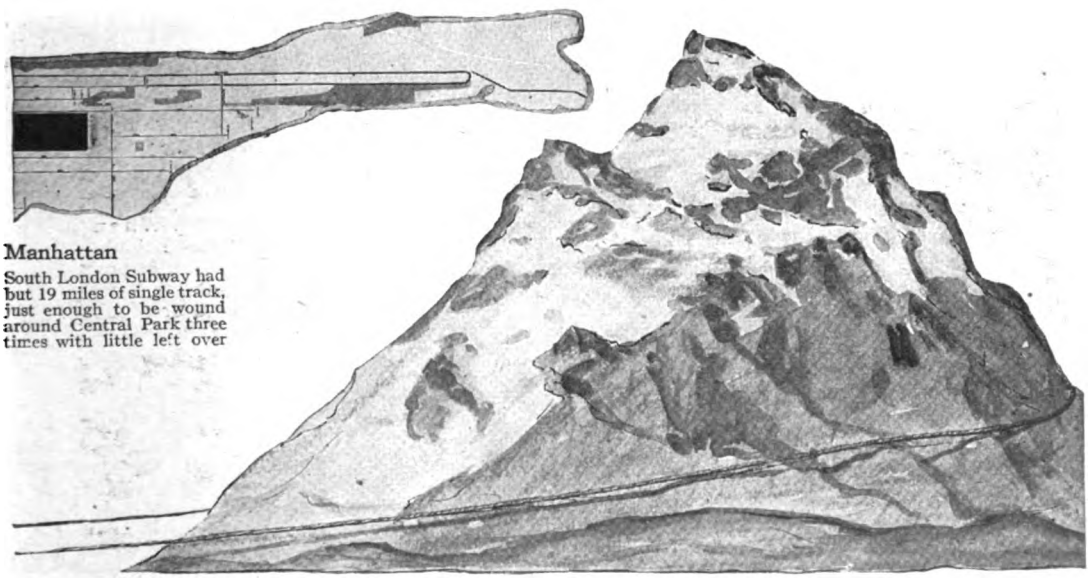


Figures Tell the Story Great Subway System

Can You Imagine It?

The New York Subway System, when completed, will be equipped to transport 3,000,000,000 passengers a year. To carry that number of passengers across the ocean would require 2,200 steamships of the size of the "Leviathan" every day. The first London Subway carried only 10,225,987 passengers in the course of a year



have been sufficient to move Mount McKinley, the highest mountain in North America, a distance of 75 feet

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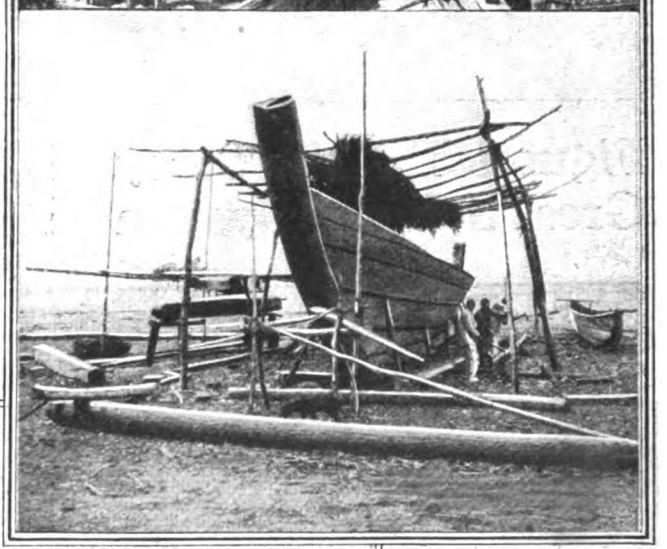
Speaking of Our Shipbuilding Programme, Let's

To the right: In the Sampan villages on the river near Colombo, Ceylon, many of the natives and their families live all the year round

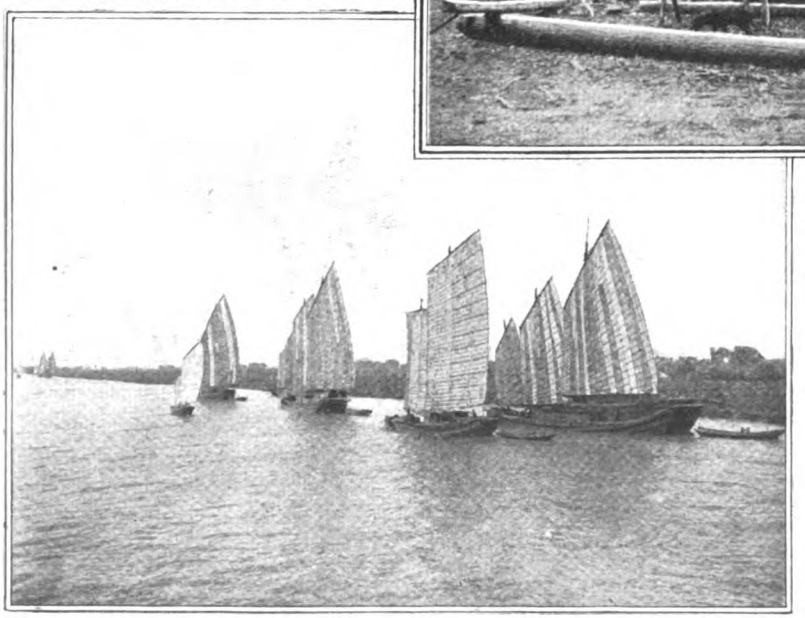
In such frail craft the Shanghai fishermen venture out far on the ocean. It is a type of ship which is centuries old



Above: When a Chinese junk is built no elaborate staging or framing is used or required

Below: Chinese salt junks slipping along lazily on the Yangtse River. The sails are made not of canvas but of bamboo leaf matting

© Newman Traveltalks and Brown and Dawson



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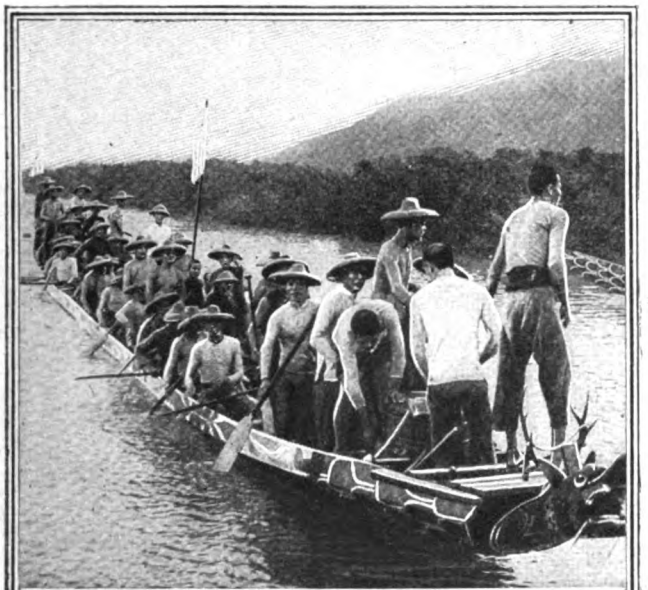
Look at Ships in Other Ports of the World



Of course the Chinese must have a "dragon boat." It is a type common on the Yangtsekiang and other rivers of China. It is crude, yet capable of carrying considerable loads

West Indian natives paddle their queer little boats with their hands

The fishing boats of the natives of Ceylon (shown below) have outriggers to prevent their capsizing in squally weather and a heaving sea

Fishermen in Hawaii are very daring and often venture far out in primitive outrigger-boats like that shown in the picture above. These boats have remarkable stability and power of resistance to the elements

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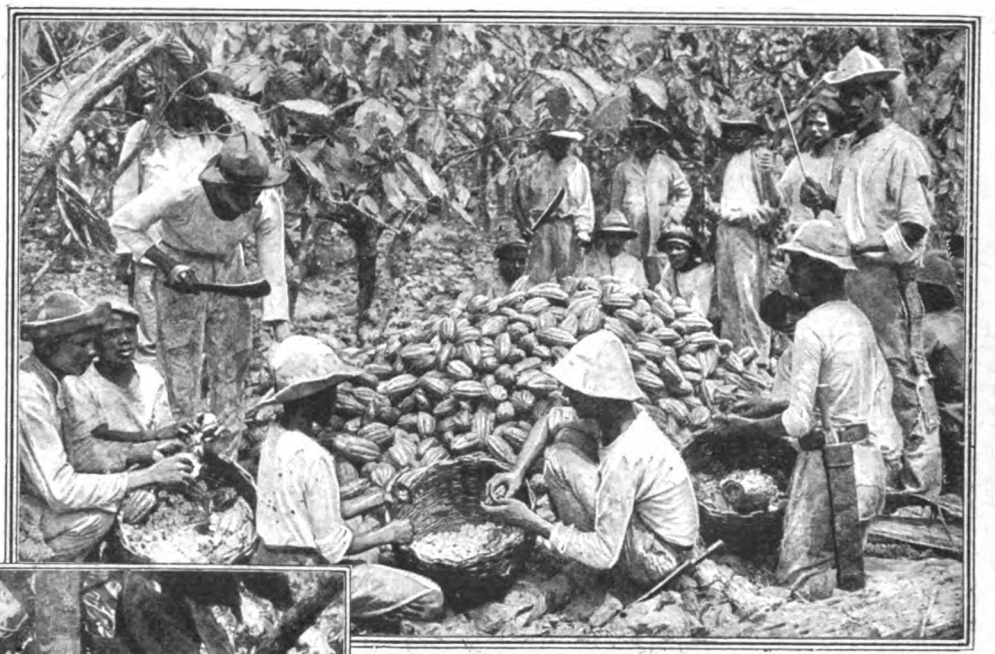
Trinidad Chocolate for You and Me



© Newman Traveltalks and Brown and Dawson

When ripe, the beans are fermented by covering them with banana leaves for about two weeks

Cacao fruit looks as if somebody stuck it on the tree. It is purplish-yellow, seven or eight inches long and contains from twenty to fifty seeds. Ecuador, Trinidad, Brazil and the West Indies yield most of the world's cacao bean output

Then the beans are dried in the sun. Native feet kick the heaps into a thin bed to dry them faster

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Hats are Really Sunshades as Worn in Malta and Korea

Women of the better class on the island of Malta have part of their cape stretched over a wire frame and use it as head covering to shade the face

In Korea it is a disgrace to be in mourning and for that reason the pedler in this picture wears a big basket-shaped hat

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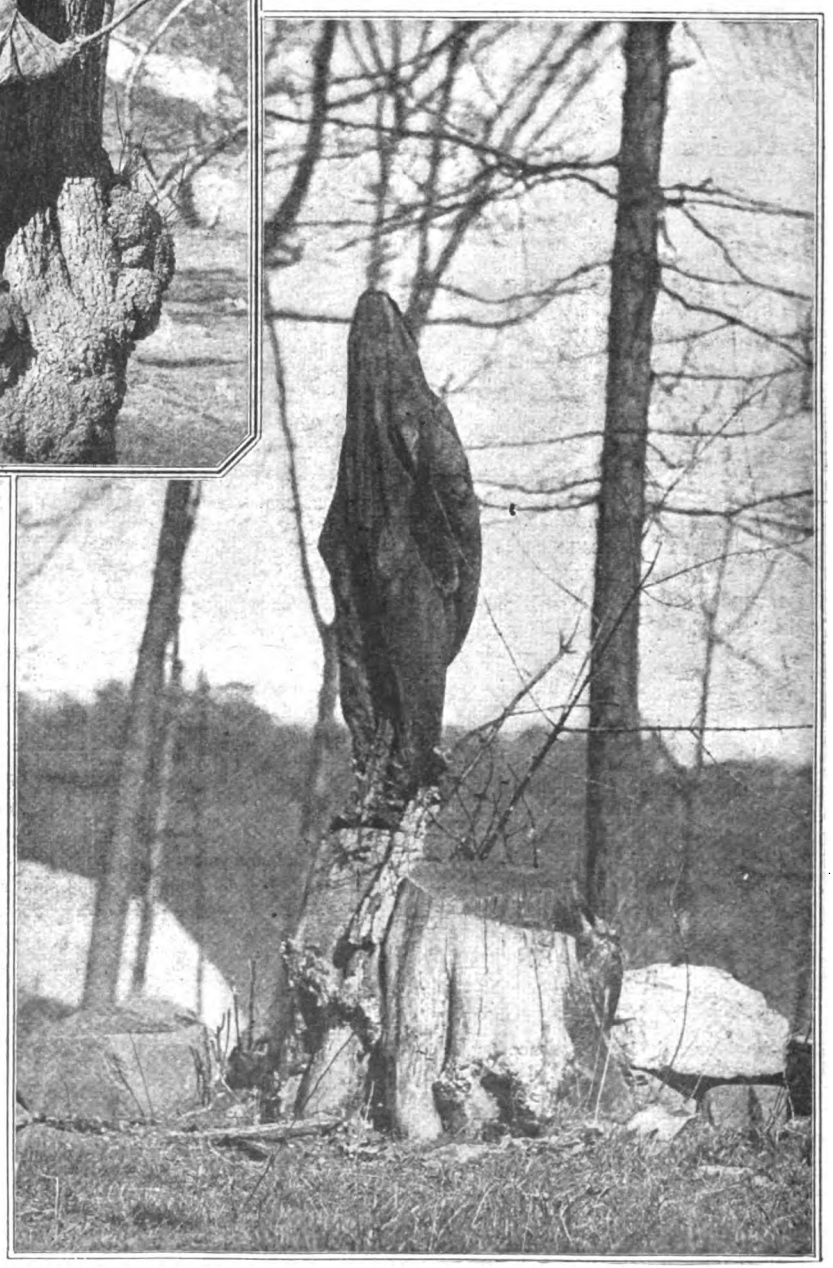
Taking Lessons from the Chameleon and the Moth

© Underwood and Underwood

The soldier in his camouflage costume bears enough resemblance to the tree trunk in front of which he stands to deceive the most astute hostile airman that flies over



To mimic a tree trunk to perfection is an art that has to be learned. The New York Board of Education has established classes for war camouflage, to teach that art

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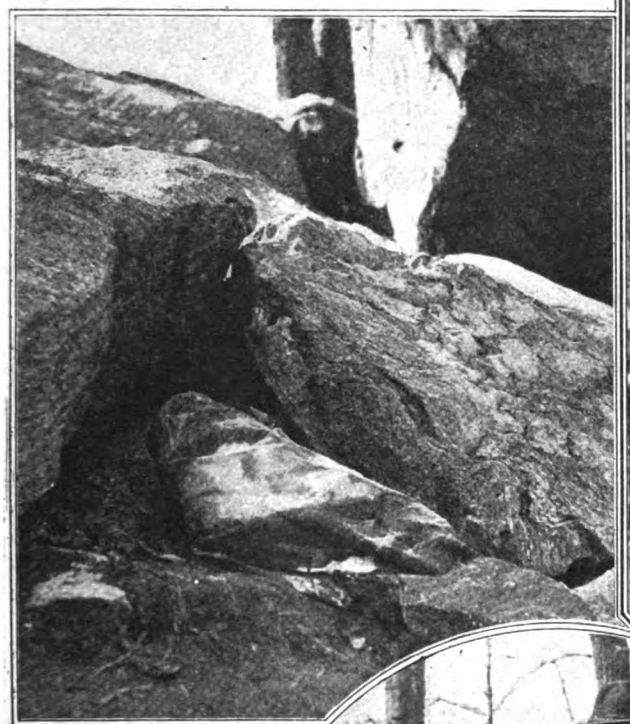
How the Gentle Art of Camouflaging Is Taught



No actor could play his part in a drama more skilfully and convincingly than the soldier in this picture plays the part of a rock. Do you think you could detect the camouflage in that mass of grayish rocks?

On Broadway a man dressed in this costume would be conspicuous enough to draw a crowd, but put him amongst rocks and trees and he will merge in the surroundings, becoming invisible

The members of the camouflage classes receive practical instruction in the principles of the art of war mimicry and are trained in the best methods of fooling the foe

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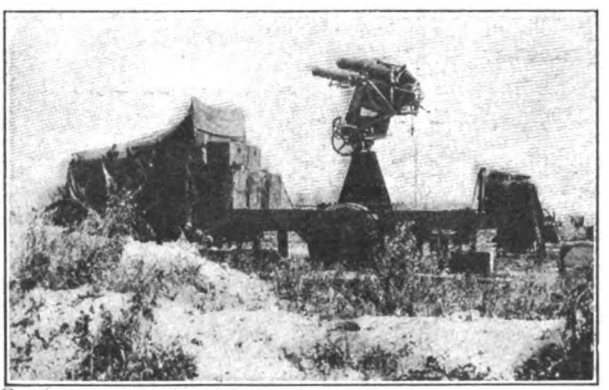
Gunning for Bird-Men

Some recent anti-aircraft guns
with improvised mountings

By Carl Dienstbach

THE art of war has reverted to a state similar to that which the introduction of the use of gunpowder and firearms produced in the fifteenth century. Then, conditions and methods had to be readjusted to meet the changes produced by a new and powerful agent of destruction, not yet fully understood; now, new means of warfare, evolved by the marvelous resources of modern science and engineering, have again unsettled conditions and caused an upheaval upon a fearfully exaggerated scale.



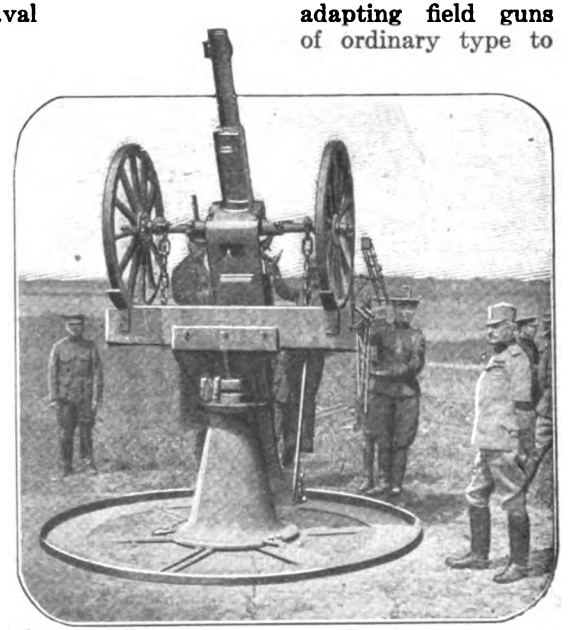
© French Pictorial Service

The Belgians mount field guns on improvised revolvable platforms to be used as anti-aircraft guns

As in the fifteenth century, infantry and artillery had to be armed with makeshifts—hand grenades and ponderous bombards, improvised under the very stress of battle. The chief importance of infantry is once more in its bodily impact; the rôle of artillery is again to smash and overwhelm everything by enormous projectiles.

When it was found necessary to use the heaviest naval and siege guns with the least possible delay, mounts had to be improvised, which bear a curious resemblance to bygone makeshifts. Even of the lighter cannons, of smaller caliber, many have undergone a curious metamorphosis which makes them resemble the medieval "falconets" which occasionally had to be pointed skyward to reach the enemy's scouts stationed on the watchtowers of castles perched on lofty crags. These modern guns also must be pointed toward the sky to fire at the enemy's scouts seated in airplanes.

Several standard types of anti-aircraft guns were invented, but so enormous was the increase in the number and activity of military airplanes and other aircraft, that the supply of standard anti-aircraft guns could not keep pace with the demand. It became imperative to improvise such guns by adapting field guns of ordinary type to



© Kadel and Herburt

A British gun, mounted on an automobile truck, can be used horizontally as well as vertically

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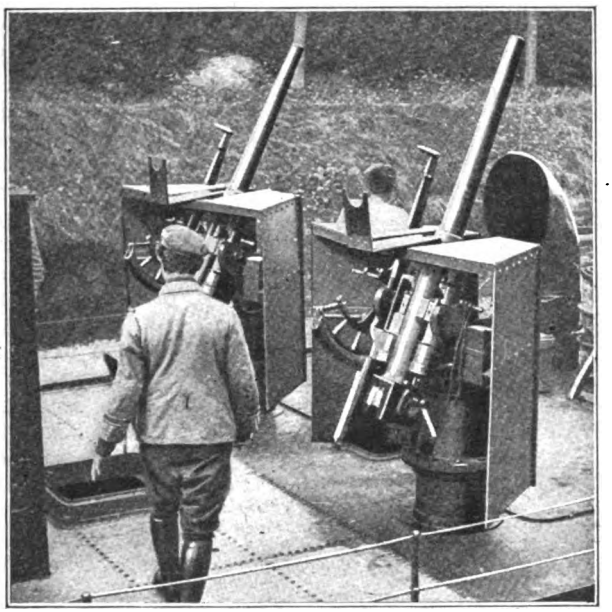
the requirements of high-angle firing. Some of these improvisations are shown in the accompanying illustrations.

Field guns of regulation type were mounted in different ways, but always so that they could be aimed vertically as well as horizontally or, changed from one position to the other with the least possible difficulty. In the case of the Belgian gun shown in one of the pictures the complete field gun, with its carriage, tail and all the rest has been chained to a column with a revolving platform. Only the barrel with its recoil tube has been utilized to adapt the gun for the automobile truck. But note the ingenious fork in which the gun is mounted. It gives the gun a complete horizontal firing circle, and, at the same time enables it to be pointed vertically with the greatest ease. This result has been achieved by constructing the fork so that it supports the barrel at a considerable distance from the base column upon which the fork is pivoted. Hence it is possible to stand right beneath the breech of the gun and to aim it as conveniently as one points a fowling piece.



By a rather crude improvisation the deck guns on this small French torpedo boat in the Aisne Canal have been adapted for use against aircraft

Twin guns are shown on a French torpedo boat, small enough to enter the Aisne Canal. That the guns are, primarily, intended to form part of the boat's armament against an enemy on shore or on water is apparent from the gun shields which give protection only against projectiles fired from approximately the same level. By a few changes in the gun shields and other details these guns have been adapted for use against aircraft, if the emergency should arise. That this adaptation is purely an improvisation is shown by the fact that the breech of the guns, when they are pointing vertically or nearly vertically, is so close to the deck that it is extremely difficult to aim them.

In contrast to the fixed gun, which can be used only against aircraft, the gun on theautomobile and the deck guns on the torpedo boat can be used at any angle desired.

Launching Seaplanes from Ships

When a big seaplane is to be launched from the deck of a ship (of whatever type) it is first "tuned up" on the launching stage. Then the ship is swung dead into the teeth of the wind and put at full speed. To make sure of the direction of the wind, for an error would mean a "crooked" run and, perhaps, the destruction of the seaplane, a jet of steam is sent up in the exact center of the extreme tip of the launching stage. When the back-blown steam streams straight along the middle plank of the stage, the wind is "right.

At a signal by the captain the pilot starts his engine full speed, while two mechanics, braced against cleats on the deck, hold back the tugging seaplane. When the "tone" of the engine is right, the wing commander brings down his flag with a sharp jerk, falls on his face to avoid a collision, and the machine, freed from the grip of the men holding it, jumps away into space from the launching stage. If everything was right, when the seaplane started, its flight will be comparatively free from risk.

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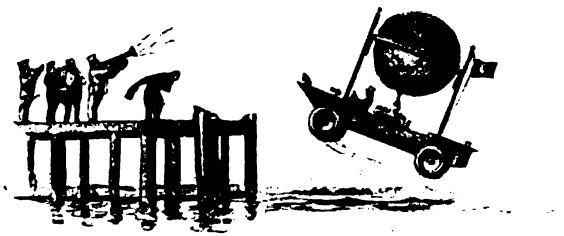
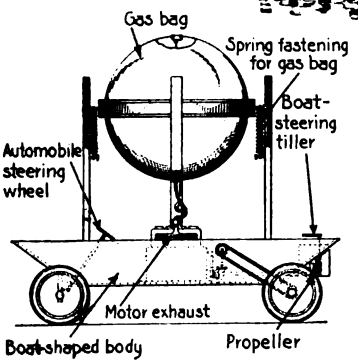
The Jelaliplane and the Mitromudscow. In Both the Balloon Figures

HAVING become a free American citizen, far from bloody Turkish massacres and the homelike Mount Ararat, a famous dry spot in the times of Noah, and having settled at Cranston, Rhode Island, where surfaces of water abound, Martin Jelalian has bethought himself of means for walking upon occidental Galilees. And so he invented the Jelaliplane. Probably his indomitable spirit could not brook the thought of walking around them or of using a skiff. Mr. Jelalian insists upon walking, especially walking "slidably" and "erectly," which means without lifting his feet or stooping over. He patterns after snowshoes or skis but finds it needful to employ one balloon and one tilted aeroplane for assistance in the desired movement. With these aids he accomplishes his purpose, he says, in his patent, in a most safe and successful manner, from which assertion it may be inferred that he has not tried any water surfaces which are more than four inches above the bottom.





The Mitromudscow is a combination balloon and automobile, ferryboat and mudscow and is named by the Popular Science Monthly after its inventor, Wozny

If you care to study the details of the Mitromudscow's construction, here they are at the left

His airplane is a hoop, with wire netting (to resist the awful thrust) and canvas, slantingly placed in the ropes between the balloon and the doughty water-walker's head. It would serve nicely as a halo, had it not been for the inventor's thoroughness in attaching two air-filled cylinders to the hoop so that it may be used as a life-saver if the balloon collapses. The footboards have airchambers underneath them and these share honors with the aeronautic devices in affording the needed support. Neglecting nothing that the most carping critic might point out as desirable, the inventor also provides an aquatic alpenstock, with buoyancy cylinders, and this he holds in front of him as a carpet sweeper.

But Martin Jelalian, bold as he is, is totally eclipsed by Mitro Wozny, a subject of Austria, but not at present so employed. Mitro can be found in Cuyahoga, Ohio, U.S.A. How he got there we can not say. It may be that one day the citizens of Ohio were stunned by his sudden and mysterious appearance in their midst in his Mitromudscow Woznyballoon, joyfully greeting the curious throngs with a strong Austrian accent.

The Mitromudscow, let us say right here, is a combination balloon, automobile, ferry-boat and mudscow, and is named after its inventor. On land it is fleet of tire. On water it is a veritable duck; in the air a dirigible balloon.

By scanning the illustration above (originally it was placed below, but it would not remain there on account of its buoyancy) you will obtain an excellent idea of Mitro's invention. The balloon, as you see, is inflated suffi-

Martin Jelalian has bethought himself of means for walking on the high seas

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ciently to relieve the wheels of all weight. Thus friction is reduced so that the vehicle will tip-toe along. Mitro can describe his invention better than we. We give him the floor but interpolate a few parenthetical comments. Gentlemen, Mitro:

"It will be understood that when the vehicle is traveling over the land under the propelling power of the motor the bag may be filled to the desired extent with exhaust gas from the cylinders so that the bag will rise. (That boy's a bear on gases). It will be understood that the buoyancy of the bag partially supports the vehicle so that the traction wheels force the device over the ground, lightly contacting the ground and skimming thereover. (When do you think the war will end?) When the device is in water, the propeller propels the device while the body only lightly rests upon the water by reason of the buoyancy of the gas bag. If it is desired to rise above the surface of the land or water, the bag will be provided of sufficient size."

Alas, poor Newton!

A Tree's Foliage Trimmed to Let Telephone Wires Pass Through

ON the suburban lines of the Chicago Telephone Company, it has frequently been necessary to cut down trees or trim their foliage in order to give telephone wires the right of way. Foreman J. Woods, chief of construction of the local telephone company in Chicago, deserves credit for a novel method of overcoming the difficulties placed in the way of telephone-line construction by trees along the right-of-way. Our illustration shows how he trimmed the branches of a tree into a circle permitting the wires to pass through, yet not marring the beauty of the tree, but rather adding to its attractiveness by giving it the unusual appearance it presents.

The wires thus permitted to go through the tree were those belonging to a telephone line connecting Morris and Lisbon, towns in Illinois.

It is not usual for the minions of great corporations to display artistic tastes. When they do, we like to mention it.

A telephone company did it—not the Society for the Preservation of Trees

© Brown and Dawson, New York

These jugs hold no circus lemonade, nor water diluted with citric acid, but pure lemon juice

Who Cares for Whiskey or Beer When Fresh Lemon Juice is so Cheap

THE jugs nestling in the big basket on the truck shown above may arouse the suspicion in the minds of prohibitionists, but the suspicion is unjustified. The jugs, big and little, contain nothing stronger than fresh-made lemon juice. The scene is in Naples and the lemons may have grown in the garden of the enterprising vendor in the outskirts of the city. The Italians are very moderate drinkers. An Italian drunkard is a rare sight. Italians love their light wine, but consume it in moderation and quench their thirst during the hot summer time principally with fruits and fruit juices, especially lemonade and orangeade. Fruits and their juices are surprisingly cheap in Italy and the thirsty Neapolitans need not spend more than a few centesimi for a jug of the refreshing juice.

Here is a hint for our advocates of prohibition. Let them popularize fruit juices as thirst quenchers in fighting the Demon Rum!

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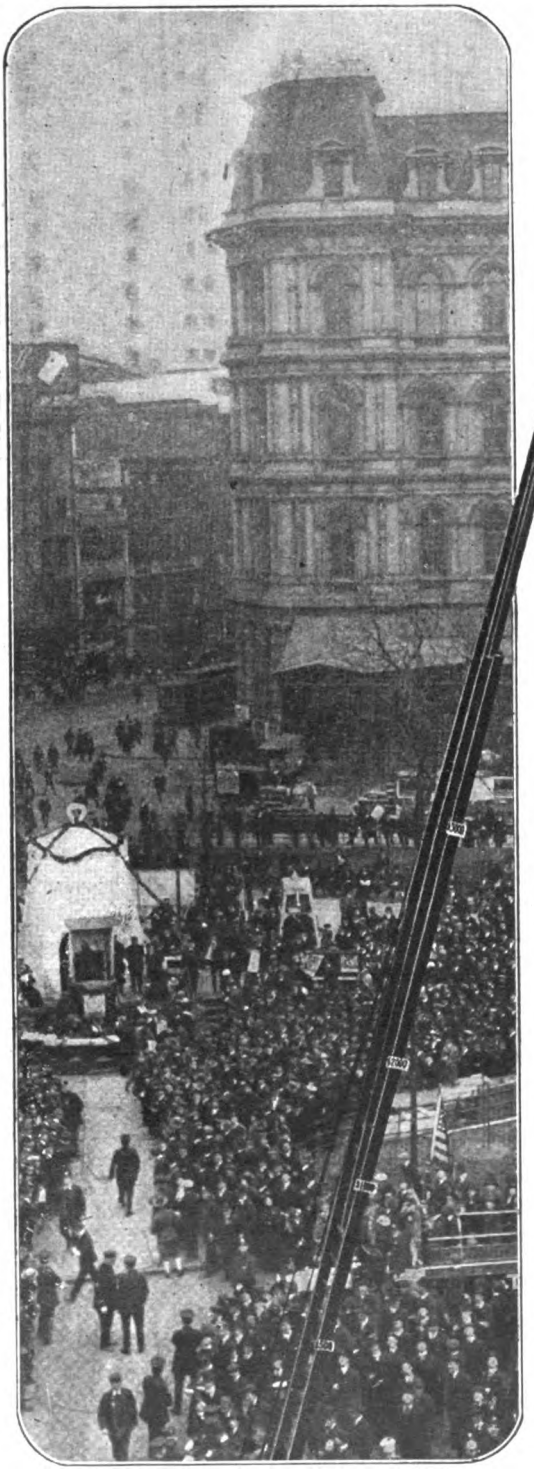

© International Film Service
Each time the fireman moved a step nearer to heaven it signified the sale of a $50 Liberty Bond

Ascending a Ladder to Encourage Liberty Bond Sales

IF he had been dragging children from the top floor of a burning tenement house at the risk of his life, Owen J. Ryan, a fireman, could not have received greater applause than he did when he climbed to the top of a ladder in City Hall Park in New York during the last Liberty Bond campaign. The occasion was the celebration of Firemen's Day at the Liberty Bell booth in the park. Every time a $50 bond was sold Ryan stepped up a round, finally reaching the summit and waving the American flag. He made several trips, each one netting the loan fund $5,000.

Do You Know Why Grass-Hoppers Spit "Tobacco Juice?"

A FRENCH scientist, Dr. E. Rabaud, has unearthed the fact that the emission of dark fluid from the mouths of grasshoppers, when captured, is a swift action, which follows the stimulation of various spots of its skin. In other words, this carefree, joyous insect, when touched by the bad boy's or the naturalist's fingers on different localities of the surface of its anatomy, sets up a "reflex process" — a high-sounding name for a message from the skin to his spinal cord, relayed swiftly back again to a nearby muscle—between the skin and the throat of the grasshopper.

The abundance of the flow is determined by the pressure as well as the spot stirred up. The amount of the "juice" is increased if the sides of the creature's throat or its front legs are pinched.

Dr. Rabaud found that the parts of the skin touched that make the tarry fluid come forth are different from the spots, which, touched, make the insect kangaroo jump. He, therefore, concludes that the surface of a grasshopper is divided up into groups of sensitive areas, one for jumping and the other for spitting.

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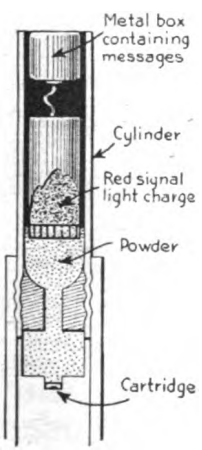
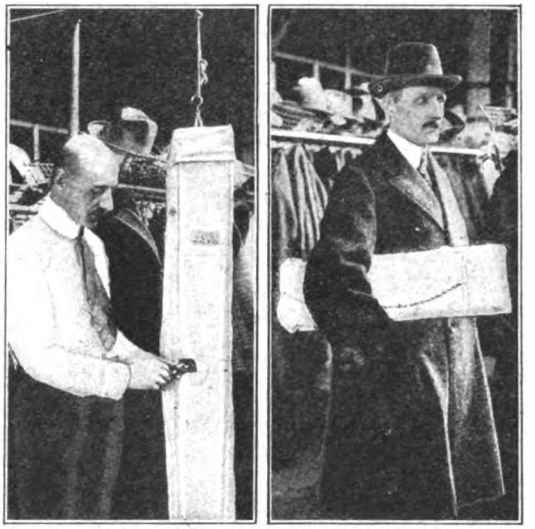
Guns That Shoot Not Shells, but Messages to Commanders

THE transmission of messages, observations or directions from the first line trenches to the headquarters of the regimental or brigade commanders behind the lines is always difficult and attended with great risks. Of course connection by telephone is maintained whenever possible. Sometimes telephone and telegraph wires are shot away. Besides, the enemy may have tapped the wires and may be able to hear every word spoken.

The Germans on the West front have used several ingenious methods for overcoming these difficulties. The observers in the observation trenches in front of the first line enclose their messages in a cylindrical metal box and shoot it by means of a grenade-thrower or a mine-thrower to the rear of the lines. The accompanying diagram clearly shows the construction of the projectile used. To the box containing the message a red-fire cartridge is attached, which is ignited by the explosion of the sending charge, and by its vivid glare plainly marks the spot where the box with the message dropped. The grenade thrower, at an elevation of thirty-two degrees, sends the box to a maximum distance of six hundred yards.



The Germans on the West front shoot off messages with mortars



The canvas locker when made into a package and as it looks when securely closed

A Portable Canvas Locker for Use at Home or Abroad

PROTECTION for clothing not in use, whether in camp, in the home, in the factory or elsewhere, is made easy by a new portable canvas locker. The device weighs but five pounds, and may be carried under the arm when folded; yet when expanded it is fifty-eight inches high, twenty - two inches deep, and six inches wide. A mirror is set into one door.

As shown in the photographs on top, it holds a man's overcoat, coat, vest, shoes, and hat without crowding, and even has little compartments for a whisk-broom and a comb and brush. A padlock protects the contents against thieves. The canvas is impervious to dust and water. A name plate on the front, which cannot be removed from the outside, makes identification easy.

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A Photograph Thirty-Nine Feet Long

A panorama of Naples, viewed from San Marino Castle, is the largest photograph ever taken

Photographs by Jacques Boyer

Retouching the mammoth photograph of Naples, after development

IN the May number of POPULAR SCIENCE MONTHLY was described a gigantic photograph of an actual battle scene, showing the storming of the Vimy heights by the Canadian troops on the morning of April 9, 1917. It was spoken of as being probably the largest war photograph ever made. It was really an enlargement of a snapshot made during the battle by Captain Ivor Castle.

Large as that photograph was, it could not compare in size with the direct photographs which were taken a few years ago in the United States to advertise a western railroad line. To take these pictures, Mr. George Lawrence of Chicago constructed a gigantic camera, about six feet high and nine feet wide, which was mounted on a railroad flat-car. The bellows could be extended to a distance of about twenty feet. The weight of the camera was in the neighborhood of 1,400 pounds.

Later a German

A bromide enlargement was made on a strip of sensitized paper forty feet long by five feet wide

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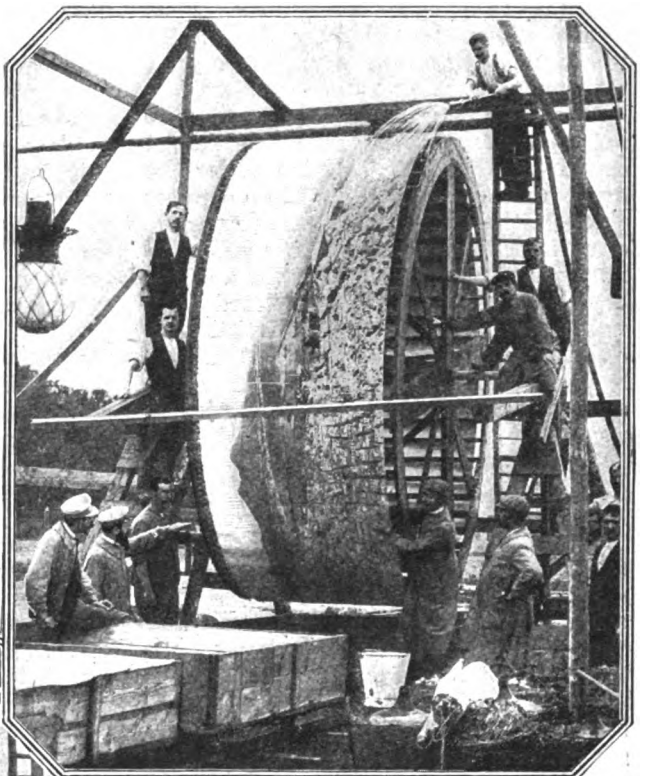
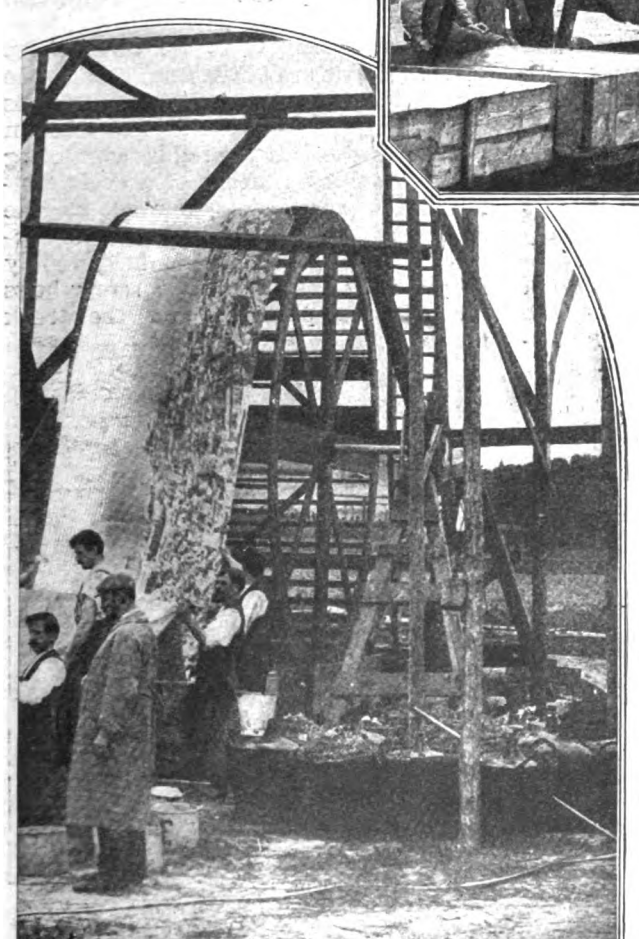
concern, at a public exhibition in Dresden, showed a still larger photograph. It was a beautiful panorama of Naples taken from the Castle of San Marino, with Mount Vesuvius and the island of Capri in the distance. The picture was about thirty-nine feet long and nearly five feet in height.

To obtain this panorama six views were made on plates, 8½ by 11 inches in size. The prints made from these plates were joined into a continuous print, and from this a bromide enlargement was made on a strip of sensitized paper nearly forty feet in length and five feet in width.





A wheel, 5½ feet in width and forty feet in circumference, was mounted upon a scaffold for developing and washing the print

To handle this large print special provisions had to be made. Three big vats for developing, washing and fixing were provided. They rested on flanged wheels running on a narrow-gage track. A wheel or drum, 5½ feet in width and forty feet in circumference, was constructed and mounted in a vertical position upon a scaffold.

The developing was done at night. The print was unrolled and slowly drawn through the developing vat, filled with an oxalate of iron solution. As the developed part emerged from the solution it was carefully inspected and all necessary corrections in the development were made by strengtheners or retarders which were applied

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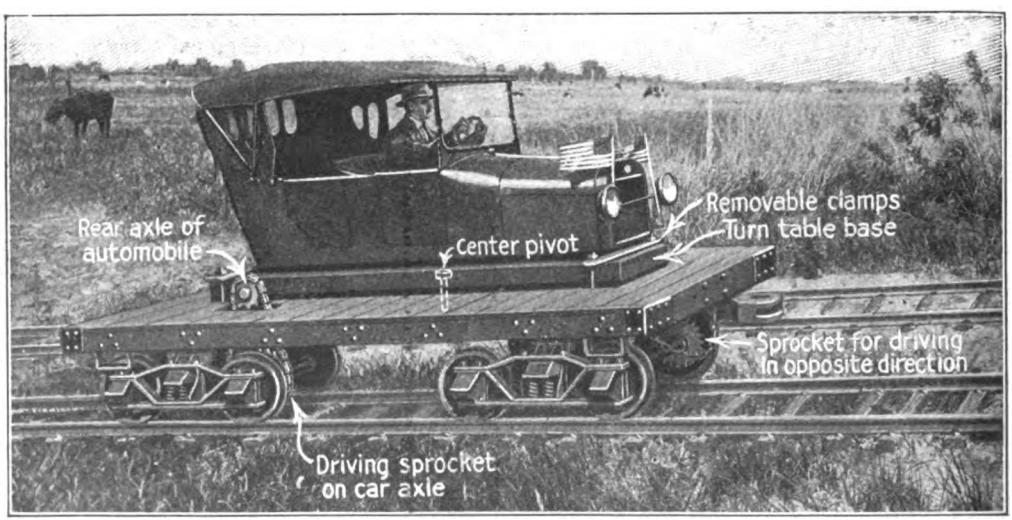
by means of sponges soaked in the respective solutions. The clearing of the print was done with acetic acid. The print was wound upon the drum and washed by a stream of water from a hose. The fixing was accomplished by rolling the vat containing the fixing solution under the drum and drawing the strip of paper through the solution for three quarters of an hour. The final washing with running water required eight hours and the drying ten hours. The completed print was turned over to several artists who skilfully retouched out any small imperfections and removed the lines which showed where the six plates were joined together.

Converting an Automobile Into a Railway Locomotive

SMALL steam locomotives such as those used to haul coal from the mines or timbers from logging camps are very difficult to purchase today. Even the second-hand market in such engines is exhausted because the equipment is being employed to carry on the many big government construction jobs. Orders for new engines cannot be filled for two or three years, because most of the locomotive factories are turning out equipment for our military needs and those of our Allies. Under such conditions, the method shown in the accompanying illustration for converting automobiles into such engines should find a wide range of employment—especially in the various mining sections of this country.

The truck consists of a small timber carriage somewhat like an ordinary railway hand car and mounted on four flanged wheels. The automobile to provide the motive power for the truck has its wheels removed and is then mounted on a platform or turntable which is supported on the carriage by a central pin. Chain sprockets are substituted for the rear wheels of the automobile and chains placed around them and the sprockets on the flanged wheels. The turntable mounting of the automobile permits it to be turned completely around, so that the radiator may always face toward the front to provide sufficient cooling for the engine water and to enable the driver always to look in the direction of travel.

When the car is to be turned, the driving chains are taken from around the sprockets on one pair of flanged wheels and placed on the other. The traction of all four wheels is secured by connecting the two axles by means of a chain running over sprockets mounted at the centers of the axles. The turntable supporting the automobile is held rigidly in place by means of two screw bolts through the platform and the truck frame.



How the automobile looks when converted into a railway locomotive. The chassis and engine are mounted on a truck. Traction is secured by connecting axles by chains running over sprockets

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Even the Animals in the Zoo Must Now Hooverize

LIONS and tigers that used to feed on juicy beef are now glad to get a chunk of old horse. Snakes are satisfied with rats and mice—except the python, which still insists on tender pork. The bears get war bread made of wheat substitutes. The New York Zoological Garden raises a large amount of both vegetable and animal foods for its wild wards. On the whole, the animals take kindly to war-time economies, for, as yet, none has been heard to complain.

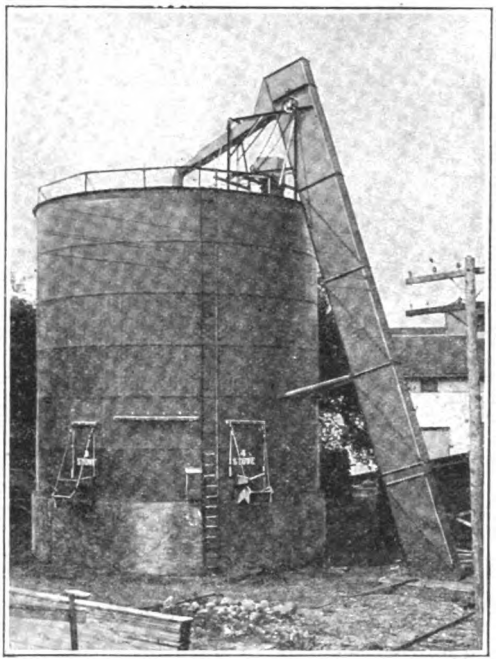
Working Under Forced Draft. Air-Cooled Overalls That Defy the Heat

AIR-CIRCULATING overalls have been introduced. Their object is to contribute to the farmer's comfort in hot weather. The garment works like a bellows, producing a draft. The harder the farmer digs or hoes the greater the draft.

On the front of the overalls is a bib, which is stiff and heavy. The sides of the garment are light and soft. When the farmer bends forward the front part of the overalls falls away from him, leaving a space which is filled with air that enters through an opening and emptying the space filled with air at the back of the garment. When the farmer straightens up again, the back fills and the front is emptied. At every step the air is made to circulate. The suit, therefore, is a kind of an air pump, operated by the moving body. Nothing is worn between the overalls and the skin, the clothing being kept away from the body by wires so that the draft may carry off the perspiration.

In order to obtain the full force of the draft, the sides of the garment are unbuttoned. Buttoning up the sides reduces the draft.

Puffed up not with conceit but with cooling air. His suit is a bellows which creates a draft around his body as he digs or hoes



A ton a minute can be loaded into this coal pocket which unloads automatically into wagons or trucks. The coal cannot be stolen

Here Is a Theft-Proof Coal Pocket with Six Bins

A NEW kind of coal pocket consists of a large steel tank built on a concrete foundation, and divided into six bins, which may be filled through one movable spout leading from the elevating device. By using an electric motor fifty tons of coal can be unloaded into the bins in fifty minutes. Their capacity is 750 tons.

The car dumps its load of coal into a pit from which an endless belt with the scoop pockets hoists the coal into each bin in succession. The bins are built with floors slanting outwardly so that wagons can be loaded by gravity.

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The end of the rubber tube in the water contains a small piece of absorbent cotton which filters out impurities

Drink from the Brook—But with a Sanitary Drinking Tube

THREE little girls, on a picnic excursion in the mountains, prepare to eat their luncheon. First, however, they voice their intention of drinking from a spring near by.

One of them produces a rubber tube about a foot and half in length and one-fourth of an inch in thickness. Placing one end of the tube in the water and the other in her mouth, she kneels down to drink. Her example is followed by the others.

The end of the tube in the water contains a small piece of absorbent cotton which filters out impurities.

Keep a Toad in Your Garden and Save $19.88 Yearly

THE toad is useful because of its diet. No less than eighty-three species of insects, mostly injurious, have been proved to enter into his dietary. In his "Civic Biology" (American Book Company) George W. Hunter says: A toad has been observed to snap up one hundred and twenty-eight flies in half an hour. Thus at a low estimate it could easily destroy a thousand insects during a day and do an immense service to the garden during the summer. It has been estimated by Kirkland that a single toad may, on account of the cutworms which it kills, be worth $19.88 each season it lives, if the damage done by each cutworm be estimated at only one cent. Toads also feed upon slugs and other garden pests.

Drop in a Quarter, Turn a Crank, and Buy a Thrift Stamp

A MACHINE has been introduced which will provide a thrift stamp when the purchaser drops a quarter into a slot and turns a crank. The apparatus not only saves clerical work, but acts as a cash register on stamp sales. In order to make the machine ready for operation one hundred thrift stamps are placed in the bank in a small, compact roll. When the roll is sold there will be one hundred quarters in the cash box, and the automatic counter will indicate that one hundred sales have been made. The banks are to be found in stores, schools and factories.

Drop a quarter in the slot, turn the handle and get a thrift stamp

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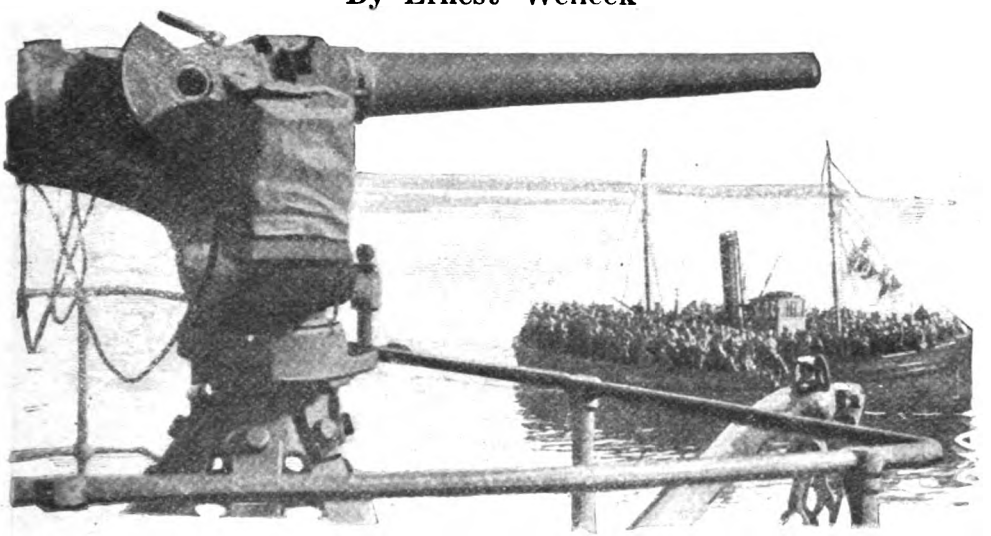
The Caravans of the Sea

Convoying ships through the danger zone

By Ernest Welleck



Landing under their own guns

WHEN Germany, shortly after the beginning of the world war, entered upon an intensive submarine warfare against all shipping belonging to the Entente Allies, the U-boat was a comparatively new and untried weapon. Step by step the submarine was developed into a most formidable fighting machine. Size, speed, dirigibility and radius of action were steadily increased. The U-boats became more efficient and dangerous, and the list of their victims increased at an alarming rate.

To meet this critical situation, to combat this lurking and elusive monster of the deep which played havoc with the shipping of enemies and neutrals alike, something, some method, had to be devised. It is not surprising that under the stimulus of urgent necessity the inventors of the Entente nations concentrated their efforts upon this vital subject and fairly overwhelmed their governments with an avalanche of ideas and suggestions for protecting ships against submarine attacks and for conducting war against the U-boats.

A few of these suggestions were clever and so promising of success that the naval authorities of the Entente countries gave them a trial. But, after many months of experimenting it was found that the only effective method of protecting transports and supply ships on their way through the danger zone consisted in convoying them by swift and mobile warships. One of the pictures which accompany this article gives an excellent illustration of this method in its most up-to-date development.

How the Procession Steams Along

The convoy is led by a torpedo-boat destroyer acting as a scout. It is followed by a light cruiser, which serves as flagship. Next comes a torpedo boat towing a kite balloon. Then follow the transports or merchantmen of the convoy in echelon formation, that is, each ship steams in the wake of its leader. There are two of these lines or echelons of merchantmen, separated by an echelon of trawlers and protected on the outer side by similar echelons of trawlers. Destroyers, steaming in a zig-zag course, form the flank of the convoy. The rear

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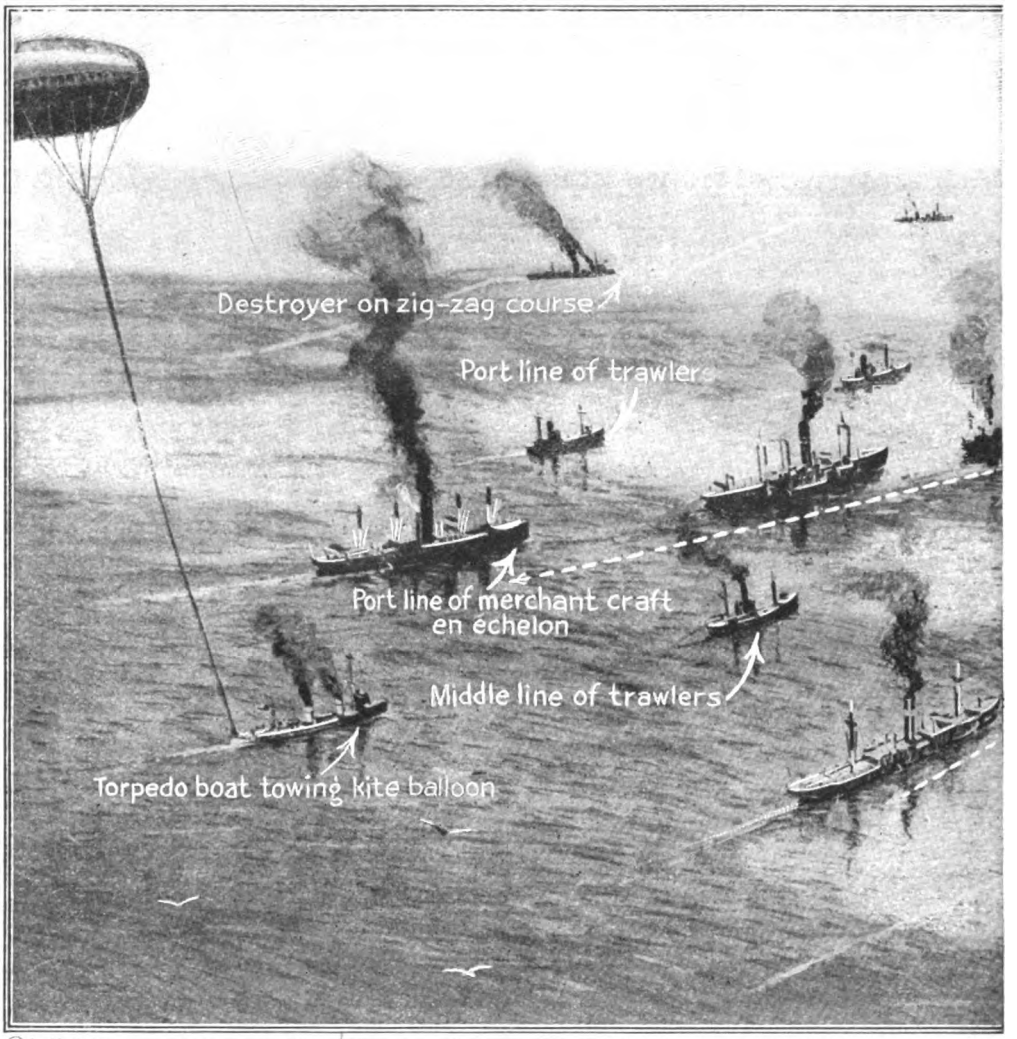
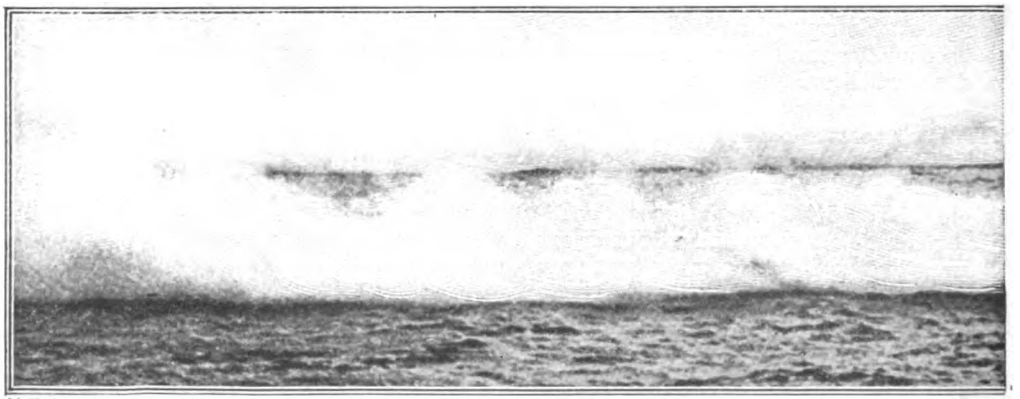
Undersea Wolves Are Lurking for the Attack,



© In U. S. by the Sphere and N. Y. Herald

New problems in convoying merchant ships were presented by the submarine; not only is it necessary to protect the flanks of the line and keep guard ahead and astern, but the ships must steam in such order in relation to their protectors



© Underwood and Underwood

Smoke-screens have been found highly efficacious as a protective measure against submarines. The point of observation of the submarine is necessarily low, so

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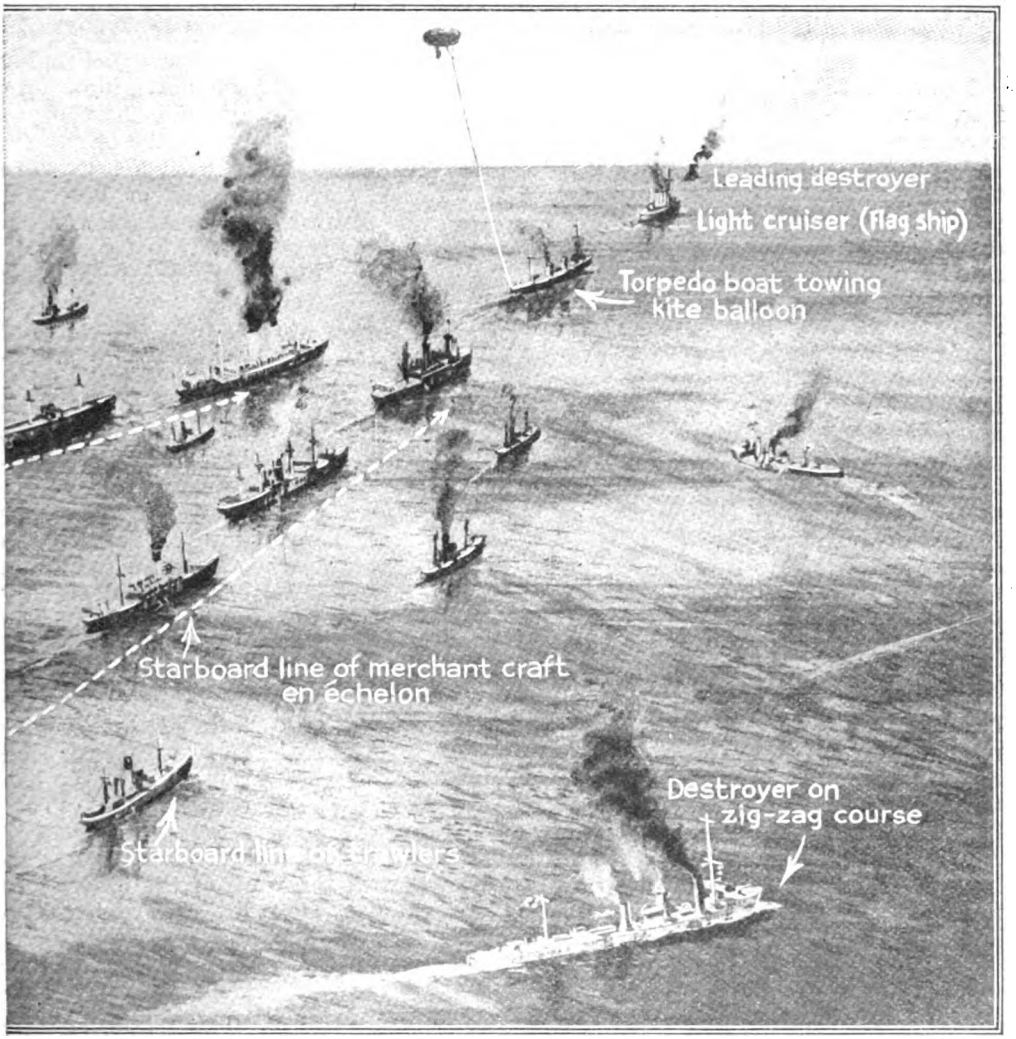
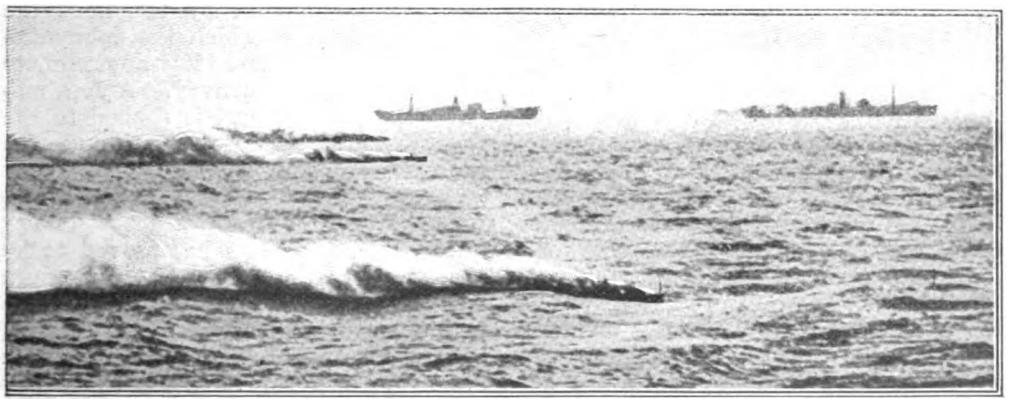
But the Dogs of War Are Ready for Them



that it will be impossible for a U-boat to use one of the merchantmen as a shield while it attacks. It would be difficult for a submarine to break through this screen of trawlers without being caught and sent to Davy Jones's locker



that even a low bank of smoke or fog shuts off the view from the submarine. Unfortunately the screen cannot be used when the wind blows in a contrary direction

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guard of the convoy consists of another torpedo boat towing a kite balloon.

These kite balloons are, as a matter of fact, one of the most important if not the most important feature of the convoy system. They are the far-seeing eyes of the sea caravan. From the deck of a ship it is extremely difficult to detect the presence of a submarine submerged so that only the periscope is above the surface. But from a balloon, towed at a height of five hundred to fifteen hundred feet, it is possible, not only to survey a much larger area, but to see submarines which are submerged or resting upon the bottom of the sea at a depth of fifty or sixty feet.

High up in the air, towed by a ship, they watch for submarines

Captive balloons were first used during our Civil War. In modern times the Japanese employed them with good effect in the siege of Port Arthur. The kite balloons used nowadays are of an approximately cylindrical form, rigged much like an ordinary kite. The harness, to which the towing cable is attached, is so arranged that the balloon cylinder always maintains an inclined position in the teeth of the wind. Suspended from the balloon is a basket which usually contains one or two observers and the necessary instruments, maps, etc. The observer is in telephonic connection with the ship towing him, and the observations reported by him are communicated to the flagship and the rest of the convoy. To keep the balloon well in the wind and to steady it, a tail of five or six small parachutes is attached to the lower end of the balloon. These balloons may be used in a moderate breeze, but cannot safely be "flown" in a wind of more than forty miles an hour. Only under the most favorable conditions can these balloons be towed at a height of 1,500 feet or more.

From his place in the basket, perhaps a thousand feet above the ocean, the observer commands a most wonderful view of the watery expanse. As far as the eye can reach the restless, ever changing ocean spreads out far beneath him. But he is not up there to admire the view, to study the picturesque beauty of the sea in its varying moods. His eye is glued to the powerful telescope or binocular with which he scans the wide expanse around him for any sign of danger. When the air is clear and the wind not too strong his task is comparatively pleasant. But, when the wind reaches the forty-mile limit, when it comes in gusts and is accompanied, perchance, by a heavy downpour of rain, the observer's position becomes decidedly uncomfortable. The basket swings most distressingly, making the taking of observations extremely difficult and the driving rain adds to the discomfort of the observer.

The physical and mental strain connected with the work of the observer is tremendous. He realizes his responsibilities and concentrates every faculty upon the task entrusted to him. The sight of a periscope or other evidence of the presence of a hostile submarine comes to him almost like a welcome relief from the terrific tension of the incessant search. After a glance at the compass before him the observer reports by telephone the exact direction in which the submarine craft was seen and its approximate distance from the convoy. A few moments later the report is flashed to the flagship and the destroyers and the necessary orders are given.

The Slow Ships Hold Back the Fleet

The convoy system has proved to be the most efficient protective measure against German submarines evolved so far, but it also has its disadvantages. Transports and heavily loaded freighters are necessarily slow. When such slow going ships form part of the convoy, the

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other, faster ships must adapt their speed to that of the slower craft, as the formation of the convoy must be maintained intact. This makes the progress of a convoy often extremely slow. When the system was first introduced fast ships, weary of the slow progress of the convoy, would break out of the line at the first opportunity and perhaps fall a prey to a prowling submarine. Since then skippers have become cautious. They have learned their lesson.

Unnecessarily to retard the progress of a ship capable of making greater speed is a waste of shipping facilities the Allies can ill afford at the present time. It would be a good plan to form convoys, whenever possible, of ships of approximately the same speed.

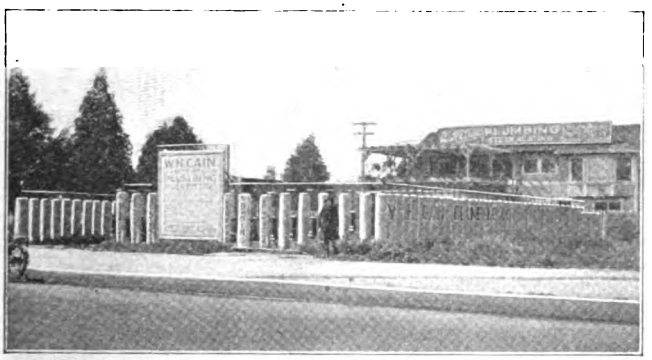
More recently the convoy system has been made safer by the addition of the smoke screen.

The skeleton of the windmill has a dress that Eve might have envied

Fenced In by Steam Boilers, He Has Reserve Stock and an Advertisement

IF you ever happen to walk down a certain street in Los Angeles, don't question the veracity of your eyesight when the craziest fence imaginable looms out before your astonished gaze. It looks as though a plumber had built a fence while in a nightmare. As a matter of fact, it does advertise a plumbing business, and it consists of galvanized iron boilers and gas hot-water heaters placed alternately and connected by regular pipe connections.

When the owner constructed this odd fence his competitors said that he must be crazy. However, he has had an excellent advertisement, and now, since plumbing fixtures are difficult to get and very costly, he is able to execute orders by drawing on this reserve stock, and is enjoying the last laugh at his rivals' lack of foresight.



This fence, made of galvanized iron boilers, advertises a plumbing business and forms a reserve stock

Hiding the Nakedness of a Windmill

THE highly decorative effect of ivy growing against the walls of castles and other buildings was discovered some centuries ago, but it remained for a very modern farmer to turn the climbing habit of the wild grape to good account. The photograph tells the story. The windmill was quickly turned from a bare framework, suggesting in its ugliness the inartistic but highly useful framework of a skyscraper, to a bower of beauty. As a matter of fact, the farmer used both the wild grape and the ivy (not the kind that poisons), and in two years had the framework well covered. And, as the owner said: "It didn't cost much." Moreover, the vine-clad windmill is a thing of beauty if not a joy forever.

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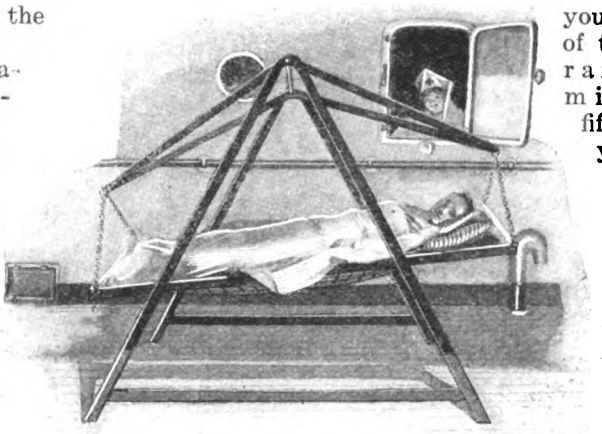
Keeping Him Quiet While the Ship Rocks

THE usual ship's hammock is of course out of the question for a man with a leg or arm in a splint, for instance, and the berths are equally useless on account of the lurching of the vessel.

The transportation of badly wounded soldiers presents a many-sided problem which experts are finding difficult of solution in spite of the many new inventions made for the purpose. The accompanying illustration shows a hammock-bed which has been found useful on shipboard.



Let the ship pitch and roll, the hammock will always be on an even keel and the wounded man is kept quiet

In most cases it is absolutely necessary that a wounded soldier be protected from jolts. He must lie flat. On shipboard that is difficult. Hence the hammock-bed. Its construction is simple. This webbing of the hammock portion is stretched out and held taut by a wooden frame. This is suspended by chains from a frame rocking on a transverse bar connecting the side supports, as shown in the illustration.

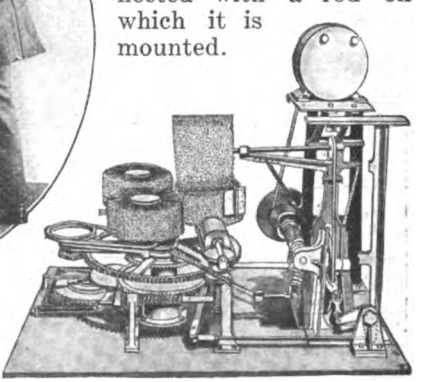
The patient is strapped to the cot so that when the vessel rocks it cannot disturb or dislodge him. The entire hammock - bed sways with the motion of the ship. The only objection which has been found to this type of bed is the sea-sickness which results from the swaying motion. This is nothing, considering the advantages of the hammock bed.

"Shine Your Shoes!" All You Do Is to Drop Dime in Slot

STEP up to the new coin-controlled boot blacking machine, ladies and gentlemen. Thrust your foot into the open mouth of the machine and steady yourself with one of the brass hand-rails. In one minute and fifteen seconds you remove your foot and gaze in admiration at your shoe. Then you thrust in the other foot and withdraw after the same interval.

First a revolving horizontal brush that follows a track around the foot rubs off the dust. On its second revolution it applies polish three times at set intervals. The work of polishing is completed by a second horizontal revolving brush. Then another brush, with its axis at right angles to the two horizontal brushes, rocks rapidly back and forth over the toe, effectively polishing that part of the shoe. The toe brush is held down on the surface of the shoe by a light elastic pressure, due to the slightly overbalancing effect of a spring connected with a rod on which it is mounted.

Drop a coin in the slot of this machine and get your shoes polished



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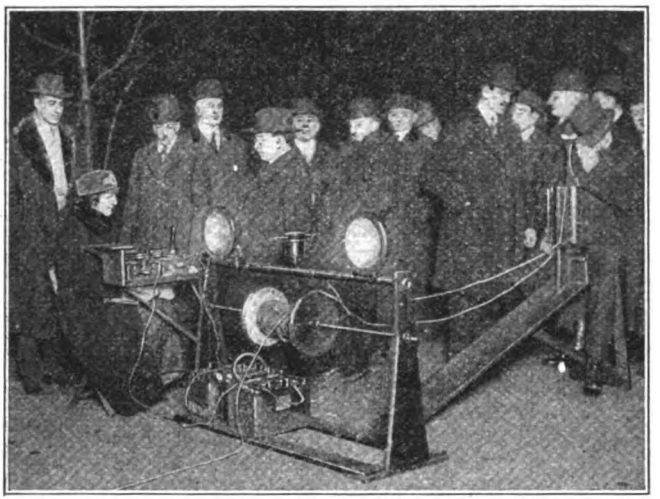
How Far Can a Chauffeur See a Man in Dark Clothes on a Black Night

FOLLOWING action on the part of the New York State Legislature to enact a better automobile headlight law, tests to determine how much light is necessary to reveal a man in dark clothes at distances of 150 feet and 250 feet in front of a car, and how much light the driver can tolerate in his eyes at a distance of 100 feet, were held in New York city. The conclusions were reached with the aid of a photometric apparatus so that the results could be recorded in candle-power.



This is the apparatus used to find out how far a man in dark clothes can be seen on a road at night

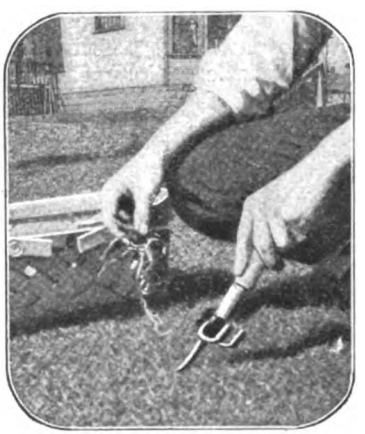
Two pairs of parabolic headlamps were mounted on stands and supplied with current from a storage battery. Forty-nine observers took part in the tests. Each one moved a handle and sent more or less current to the lamps, thus adjusting the amount of light to a point where he considered that he could see the person in dark clothes distinctly enough for safety in driving.

As might have been expected the results showed a wide variation in what was considered desirable intensity. The candle-power received by different observers to see a person in dark clothes 150 feet ahead of the automobile ranged from 1,000 to 10,000. The average of the observations was 3,200.

A Twenty-Five Million Dollar Ordnance Base in France

FOR use by the American expeditionary forces in France there is at present under construction a huge ordnance base which will cost twenty-five million dollars. It will include many storehouses, shop buildings, magazines, and a large store of machine tool equipment. Repair plants on a large scale for guns, carriages, small arms and machine guns, horse and infantry equipment are provided for; also reloading plant for artillery cartridge cases, carpenter shops, and other auxiliary buildings. A force of 450 officers and 16,000 men is needed to maintain the base, and about half of this force has been obtained through a special recruiting campaign instituted by the Ordnance Base Bureau.

Weed the Garden With This New Tool



Try this device for weeding in your little war garden

DANDELIONS, thistles and other kinds of weeds may be rooted out without disturbing the soil by means of a weeder provided with a three-inch digging blade that penetrates the soil like a knife. The implement pulls out the top, root and all. The blade is made of steel. A wooden handle attached to the device prevents cramping of the hand and fingers.

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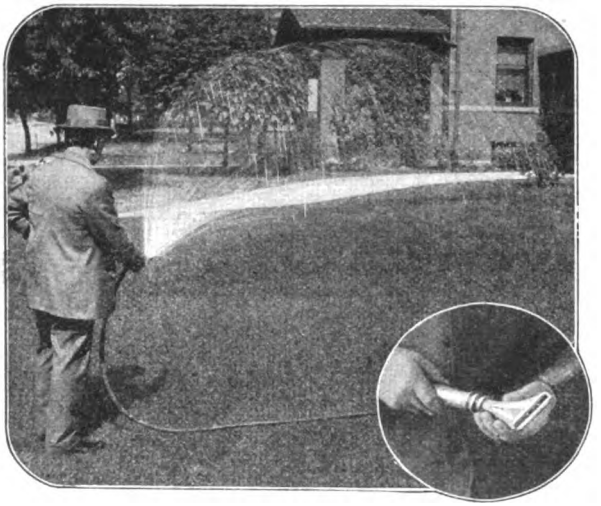


The narrowed outlet causes a fan-shaped stream of water to be ejected at high pressure and speed

European Cattle Must Eat Leaves and Wood-Pulp

IN several European countries, notably Sweden and Germany, the scarcity of cattle-fodder has led to experiments with various substitutes for the usual feed given to cattle. It has been found that dried wood-pulp provides a good cattle-fodder when mixed with molasses and albuminous substances. In Germany straw fodder is being manufactured on a large scale; while in Sweden reindeer moss and Iceland moss are extensively used as fodder. Horses are said to thrive very well on a diet of rushes.

Crush the End of a Pipe and You Produce a Perfect Garden Nozzle

THE garden sprinkling nozzle developed by Charles H. Stephan, of Springfield, Ohio, looks as if it were a piece of plain piping, struck with a hammer at its end. Though this is not exactly the way it is made, it is shaped nearly as quickly by a single blow in a forming press.

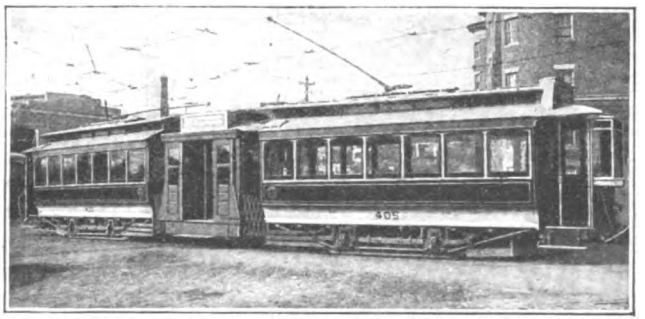
Two purposes are accomplished by flattening the end of the nozzle. First, the water is crowded through a restricted area so that it is ejected at great speed and pressure. Then, the flared end of the nozzle spreads the water into the shape of a fan. These two effects added together cause the water to spread over the largest possible amount of lawn.

Before the water leaves the nozzle, moreover, it will strike against an upright ridge. The stream of water is made to scatter further, since its impact against the ridge forms a delta-shaped spray.

Bostonians Ride in "Snake" Cars That Wriggle Around Sharp Corners

SOME Boston streets have such sharp corners that short cars must be employed. But you can't pack many people in small cars. So some bright Boston mind hit on the idea of combining two short cars by means of a vestibule between. The vestibule is almost square and is actually hung from the ends of the two cars by hinged pins so that very sharp curves can be rounded with safety. In the vestibule, which serves both as entrance and as exit, stands the conductor with his fare-box. Bostonians have named this contrivance "snake car," "vertebrated car," and "two-room-and-kitchenette" car.

The use of these cars is really a conservation measure, since old cars have been thus saved from the junk heap. In the picture two twenty-six passenger cars are joined to the "kitchenette." These are an old type with only four wheels to a car.



Some bright Boston mind hit on the idea of combining two short cars with a vestibule to form the "snake car"

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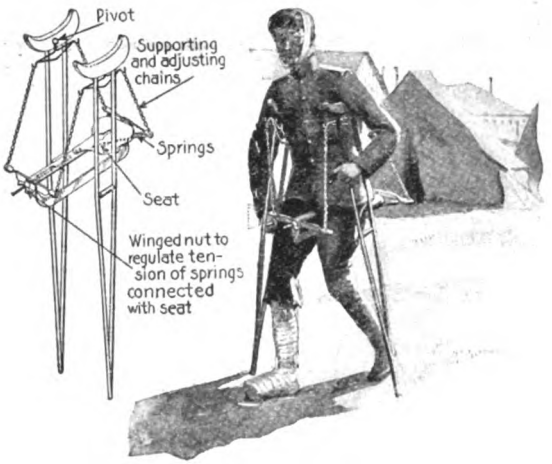
Now the Crippled Soldier Can Do His Walking Sitting Down

WOUNDED soldiers and ordinary invalids who are compelled to use crutches for long periods often suffer from "crutch paralysis," caused by the great strain and the pressure of the arm rests of the crutches upon the nerves of the arm pits. Two ways to avoid this have been devised recently, in both of which the invalid is enabled to sit down while he walks.



He sits in a swing as he hikes on his crutches and so dodges arm-strain

One of these boons to the crippled—shown near the top of this page—provides a swinging seat suspended between the crutches by chains or straps attached to the lower side of the arm-supports. It is the invention of Walter Clifford, of London. The seat may be shaped like a bicycle saddle, or may consist merely of pads resting upon springs. The height of the seat can be adjusted to suit the user and the entire seating device can be removed altogether when not needed by taking it off the hooks. By means of straps around the chest, or over the shoulders, the crutches may be secured to the body, leaving the invalid free to use his arms and hands.

The other ingenious device goes even further in that it not only relieves the arms from crutch strain, but enables the user to exercise his legs as much or as little as he chooses. It is especially designed for those who do not have perfect control of their legs. The weight of the body rests either on a padded spring seat or on the shoulder supports, and both are adjustable.

He can give his legs as much or as little work as he likes

The Various Ranges of Electric Searchlights on the Sea

RANGES of electrical searchlights vary, from between one thousand to two thousand yards in foggy weather to ten thousand yards or more when the air is very clear. The average range is approximately six thousand yards, but there are cases on record where ships have been spotted at a distance of nine miles. These figures are based on a sixty-inch mirror and a twenty-thousand-watt arc and are accurate.

What Sounds Can Aviators Hear at Different Altitudes?

THE famous French astronomer, Camille Flammarion, gives in one of his reports the heights at which certain sounds from the earth are heard from balloons.

At an altitude of 3,000 feet the croaking of frogs was distinctly heard. At the height of 3,225 feet the rolling of a cart was made out.

At 4,550 feet the roll of a drum and the music of an orchestra were distinguished; at 5,000 feet the sound of a church bell, the crowing of a cock and sometimes the shouts of men and women. Going 900 feet higher still he heard the report of a musket and the barking and yelping of dogs.

The rumble of a railway train rose to a height of 8,200 feet and the whistle of a locomotive engine to nearly 10,000 feet.

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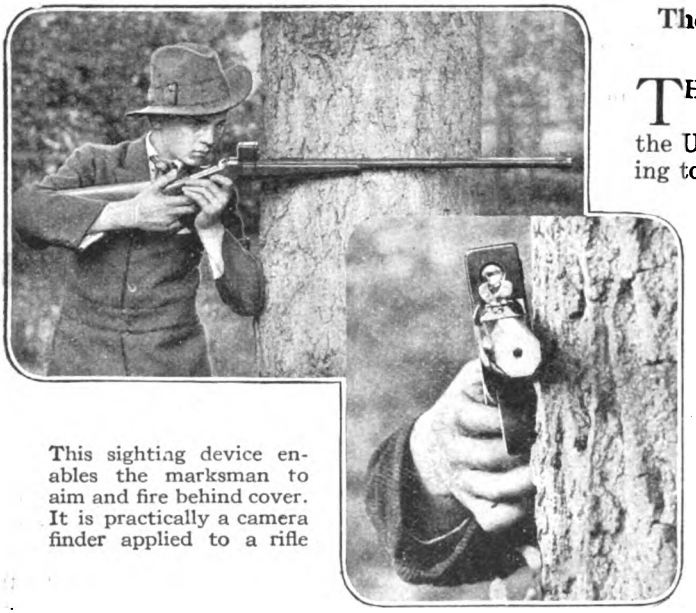

This sighting device enables the marksman to aim and fire behind cover. It is practically a camera finder applied to a rifle

The Non-Ricochet Shell Is a New Terror

THE non-ricochet shell has been used with success by the United States Navy, according to a public statement made by Chairman Oliver of the House committee investigating the conduct of the Navy.

In the past, there have been designed projectiles that will dive, but it was difficult to construct a fuse that will not cause an explosion upon contact with the water. The new shell is a flat-nosed contrivance which, on striking the water, continues its downward course at a slightly lower angle until it reaches its objective. It may be fired to strike the water on the near side of the target, a periscope, for instance, and submerge until it reaches its objective, a submarine, for example. An ordinary projectile, failing to hit the target but striking the water, will sometimes leap into the air and pass over its objective.

Using the Camera Finder as a Rifle Periscope

A SIDEWAYS periscope invented by Colonel Kauchich of the Austrian Army permits a sniper to hide behind a tree and fire without exposing more than his elbow. The invention operates on the same principle as the finder of a camera.

Mirrors are placed at angles of forty-five degrees near openings at each end and on opposite sides of a square tube attached to the barrel of the rifle just beyond the hammer. The reflection of the target is caught in one mirror, and this in turn is reflected through the tube to the other, set directly over the barrel, enabling the marksman to aim correctly without danger to himself.

"Lucky I had my steel knuckles on in that raid," says Files on brigade. "What if it had hit my bare hand!"

Armoring the Infantryman's Knuckles with Steel Bullet Deflectors

IT occurred to C. H. Gavin, of Natick, Mass., that every part of a soldier's anatomy was better protected than his hands, which are really his most valuable tools. So he invented a protector in the form of a piece of steel bent to fit the back of the hand and held in place by a steel strip passing across the palm.

This hand armor does not interfere with the action of the hand in any way. A soldier can dress, shave, eat, and handle his rifle without the least handicap.

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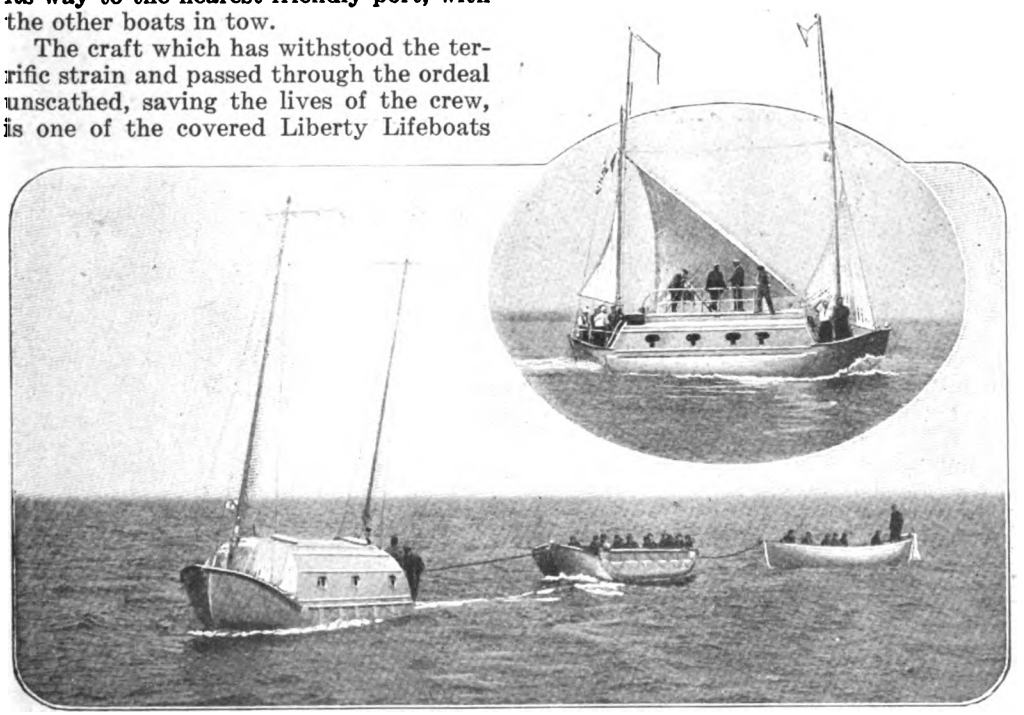
She Always Rights Herself

Stanch, buoyant and equipped with a powerful gasoline engine, the Liberty Lifeboat is designed to weather all storms

"ALL hands on deck!" The captain's stern command rings out clarion-like through all parts of the big freighter, which lists heavily to port since the explosion of the torpedo a few minutes ago. Nevertheless, the crew manages to lower several lifeboats, big and little.

Now the big ship lurches and sinks beneath the waves. The starboard lifeboat with its load of men is nearly drawn into the vortex and the men work desperately at the oars to keep afloat. Only a short distance from the small boat the big power lifeboat is seen, slowly rocking and turning in the widening whirlpool caused by the sinking of the ship. It has withstood the tremendous pressure of the water. Quickly righting itself it has bobbed to the surface like a cork. Ten minutes later the big lifeboat, under the power of its gasoline engine, starts on its way to the nearest friendly port, with the other boats in tow.

The craft which has withstood the terrific strain and passed through the ordeal unscathed, saving the lives of the crew, is one of the covered Liberty Lifeboats invented by Captain A. P. Lundin. These boats, thirty feet in length and about ten feet beam, are built of steel and protected by thick fenders of balsa wood. So great is their buoyancy that even if capsized by some accident, the boats will right themselves in a few seconds. The most important feature is a powerful gasoline engine of twenty-four horsepower, capable of propelling the boat at a speed of six to seven miles an hour. The fuel capacity is about one hundred and fifty gallons, enough to carry the boat about three hundred miles. The total weight of such a boat, including its permanent equipment, is about 9000 pounds. Masts and sails or even a radio equipment may be carried by these boats which, being extremely buoyant and completely covered, afford protection from the heaving sea and the inclemency of the weather.



A Liberty Lifeboat, equipped with engine and wireless, is shown here towing two open lifeboats. Above, it is shown with sails as an auxiliary to its gasoline engine

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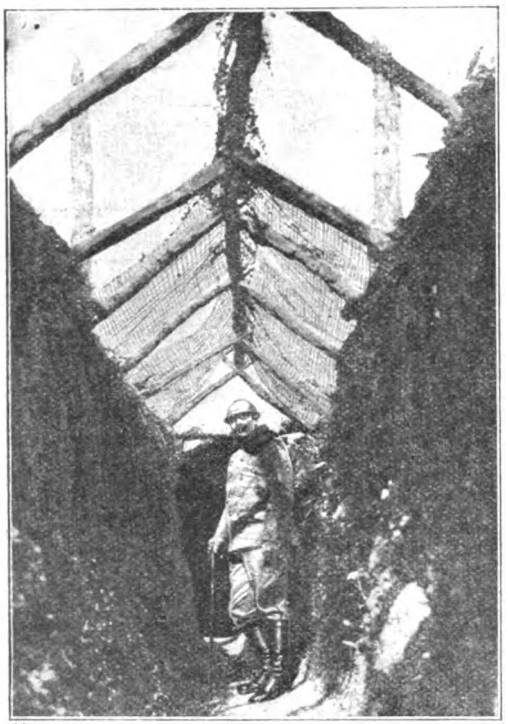


© International Film Service

Above his head is a wire netting which deflects the fragments of bursting grenades and bombs

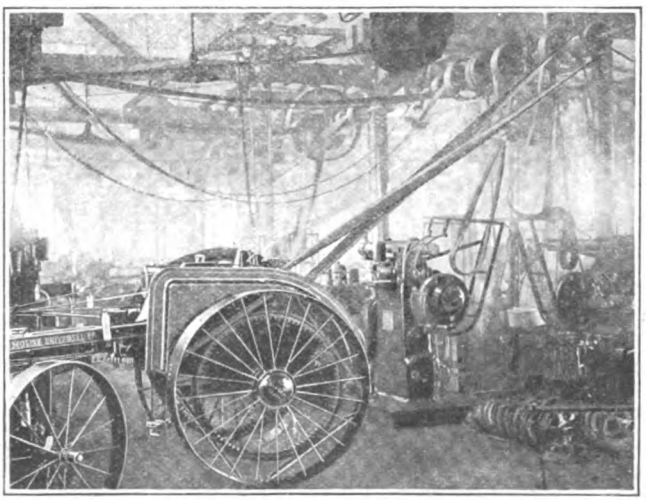
Protect Your Trench with a Deflector Made of Wire Netting

THE trench mortar fires its missiles so that they fall almost vertically into the opposite trench; the hand grenade follows a similar course. Shrapnel is timed to explode so that its bullets spray the ground below like rain. Now you understand why a trench cover is employed on the Western front, consisting of a sloping wooden framework on which is stretched a screen of wire netting. The object is to deflect the grenades and small shells which would otherwise explode in the trench. By deflecting the fragments of exploding missiles the screen acts as a shelter.

Making Tractors by Using Tractor Power

A SHORT time ago the transformer through which the electricity passes for supplying the power for a large tractor plant in Illinois was overloaded and consequently burned out. Every wheel came to a standstill—a serious matter for the factory which had been running at top speed to fill orders. In this emergency it occurred to the superintendent to use a number of tractors in stock to supply the necessary power to manufacture more tractors. The machinery of the tractors was connected by belts with the pulleys driving the various shapers, drilling and milling machines. In a few hours the plant was humming again.

The controllable governor of the traction engines made it possible to adjust the speed of the engine to that required for the machinery, which varies between six hundred and fourteen hundred revolutions an hour. The tractor engines stood the test well, although some of them were run at overcapacity for forty-eight hours without slowing down. Then the fuel tanks were refilled and they were started again and run for seventy-two hours without stopping. The picture on the left shows one of the tractors at work.



The versatile superintendent of a tractor plant in Illinois made the tractors reproduce their kind

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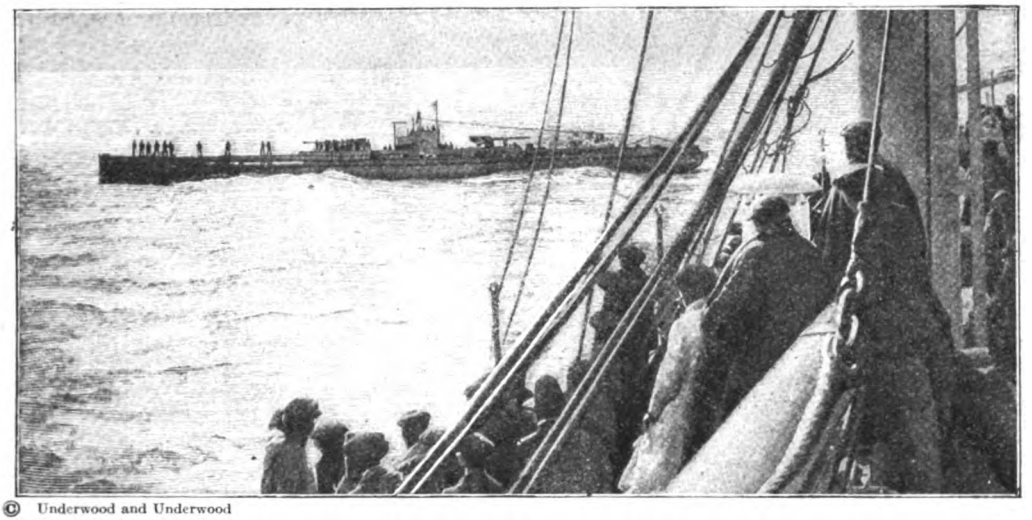
Terrorizing Our Atlantic Seaboard

Depth-bombs, nets, mines, destroyers, and seaplanes have not exterminated the pest of the seas nor kept it at home. How can America protect herself?

By Simon Lake



© Underwood and Underwood

The German terror of the sea has become more terrible. The latest cruiser type, here pictured, the type that probably sank ships off our coast, is about 250 feet long and is armed with two 5.9 inch guns. She can fight armed merchantmen, old destroyers, and the average patrol

Mr. Lake needs no introduction to our readers. He is one of the pioneer inventors who gave us the practical submarine. He has been employed at various times by the governments of the world to design or build submarines, and it was he who taught the Krupps how to build U-boats.—THE EDITOR.

ALTHOUGH the U-53 voyaged across the Atlantic, slipped in and out of Newport and then sank half a dozen ships off Nantucket at a time when we were still neutral, although the *Deutschland* made two highly successful and profitable visits to these shores, the recent attacks of submarines on ships off the Atlantic coast amazed us with their dramatic suddenness. But, then, surprise is the very essence of the U-boat's methods. A full week elapsed before the Government was aware of the first sinking. The American public naturally asks itself: What can be done to stop the Germans?

Dernburg, of unsavory memory, recently announced that the average cargo is worth $175 a ton and that it costs $250 to supply each new ton of shipping. At this rate, estimates the English naval critic, Arthur Pollen, the submarine war has already cost the anti-German world over $6,150,000,000. In four years about 22,000,000 tons of shipping have been lost.

In the third year of the war, by which time it might be concluded that the various methods devised for coping with the submarine would have been made truly effective, about three million tons were sent to the bottom.

And what is the remedy proposed to offset this continuing loss? To build ships faster than the U-boats can sink them. To me nothing is more ridiculous. Even admitting that all the tonnage required can be produced in the way of surface ships, it must also be admitted that to do so entails the employment of thousands of workmen and thousands of tons of material required for other purposes. A crumb of comfort is found in the fact that the sinkings are not quite so numerous as they were two years ago. There are fewer ships to sink. Besides, captains are more cautious than they were, and nets and patrols count for some-

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thing, however little. It remains to be seen if there will not be a marked increase in the sinkings as soon as the new ships that we are building are commissioned.

Submarines Are Not Easily Sunk

How many submarines have been sunk since September, 1914? No one knows. But despite everything, the most optimistic compiler of statistics would not place the number at more than one hundred. Commander Taussig of our navy recently said that "a submarine is a very difficult bird to catch." He had himself engaged only one U-boat in seven months and was not sure that he had sunk any.

© International Film

Saved with all her nine lives

Submerged, a submarine must keep moving or else must rest on the bottom; and this last is impossible except in depths which are less than two hundred feet. Now the Atlantic seaboard is literally made for concealing submarines. Taken as a whole, it is a long stretch of sand which slopes out into the ocean very gently. Within a hundred miles off the coast the submarine can find a resting place that is ideal.

Those who place their reliance on seaplanes and dirigibles to detect a submerged submarine know little of the difficulties that confront the observer in the air. It is only in still, clear water that a U-boat can be seen beneath the surface. In even moderately rough water nothing is visible; and the water is usually more than moderately rough. Moreover, let it not be forgotten that many long hours elapsed before one of the lifeboats cruelly set adrift by the Germans after sinking a ship off our coast was picked up; no seaplane had helped in her recovery.

A U-Boat Needs No American Base

We read much nonsense about mysterious U-boat bases on the Atlantic coast. No land base is necessary. A German submarine of the latest cruiser-type is of about two thousand tons displacement and is about two hundred and fifty feet long. Her carrying capacity is easily six hundred tons. Suppose that four hundred tons of fuel-oil are taken on board, one hundred tons of shells, bombs and torpedoes, and one hundred tons of food. With such a supply of stores she could prowl in our waters for many weeks, and even for months. She would husband her fuel, jogging along at about ten knots, as a rule, and attaining a maximum of fourteen only when she is bent on overhauling a fleeing ship. If a base were necessary an out-and-out submarine cargo-carrier of the *Deutschland* type would answer all purposes.

There is but one remedy, in my opinion, and that is to pit submarine against submarine. Build submersible cargo-carriers, like the *Deutschland*, and the Allies may snap their fingers at the U-boat. I have advocated the plan in the POPULAR SCIENCE MONTHLY, and in other publications. It is unnecessary to repeat the details. Since I wrote for the POPULAR SCIENCE MONTHLY I have studied the subject further. I have even designed a submarine cargo-carrier according to the specifi-

© International Film

They were on the "Texel", torpedoed and beached off New Jersey

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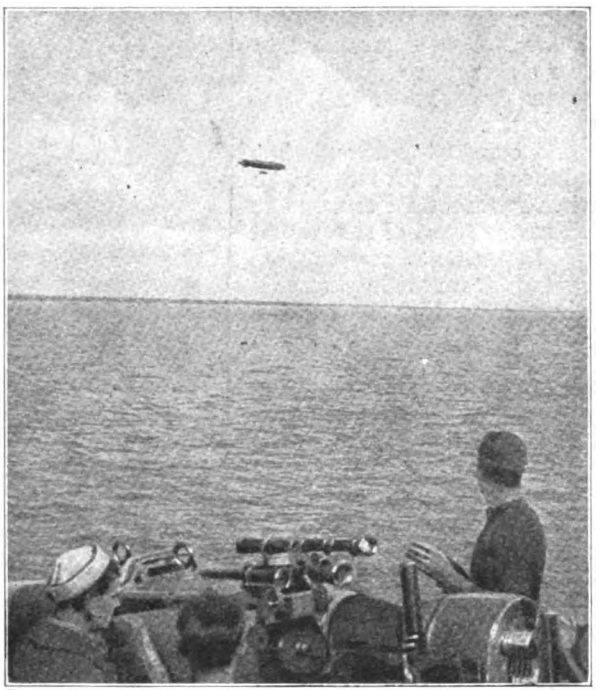
cations of Lloyd's—specifications which are followed the world over in building surface ships. To my astonishment the resulting vessel proves to be far stronger than I had imagined. It would actually be able to withstand submergence to a depth of eight hundred feet without collapsing. No submarine of the present day could descend so far in safety.

The Armored Submarine of the Future

Now that its radius of action has been so tremendously increased the submarine problem becomes more difficult of solution. The mid - Atlantic becomes as dangerous as the waters surrounding Great Britain.

The new German diving cruisers carry 5.9 in. guns and can fight. We read almost every day of engagements between armed merchantmen and U-boats. In other words, the submarine does not even have to submerge in order to escape. Safety is now sought beneath the waves only in desperate situations. As for the many patrol vessels that swarm in European and American waters, most of them are too slow and too lightly armed to be of any real value. Thus, it is said that the Ford submarine chasers are to be armed with only four-inch guns.



© International News

Far, far out at sea the navy's dirigibles ("blimps" of the English model) hunted for U-boats and for survivors in life boats

What Von Tirpitz Wanted

We have here some indication of what the future holds forth. U-boats will unquestionably be armored; they will carry heavier guns; they will be larger; they will be faster.

If I know anything of the German mind and of German technical boldness—and I may lay claim to some such knowledge in view of my past relations with the German navy and with the Krupp works—the Germans are not unlikely to produce an armored submersible during the present war, if it lasts much longer. About twelve years ago, at a time when I was asked by the Krupps to rectify some errors that had been made by them in building submarines for the Russian government, I met the redoubtable Admiral von Tirpitz. I showed him the plans for two submarines — one a defensive type, the other an offensive type. The offensive type had an armored gun turret such as I am now advocating. When von Tirpitz saw the blueprints of the offensive type, he brushed aside the plans of the other and said: "This is what we want."

At that time the Navy Department of the United States was taking a rather lukewarm interest in submarines and had not made up its mind in what particular niche the submarine fitted. But von Tirpitz, father of the German navy, von Tirpitz, the advocate of ruthless submarine warfare, saw the possibilities at once and displayed interest in a type about which our own officers are still skeptical. It is not likely that he has forgotten his desire for a craft which would be a kind of submersible battleship and which would be able to take its place lined up with dreadnoughts.

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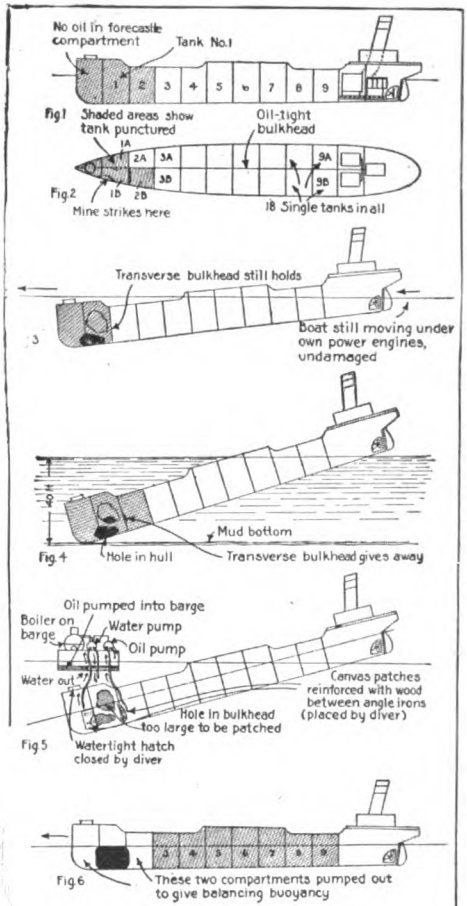
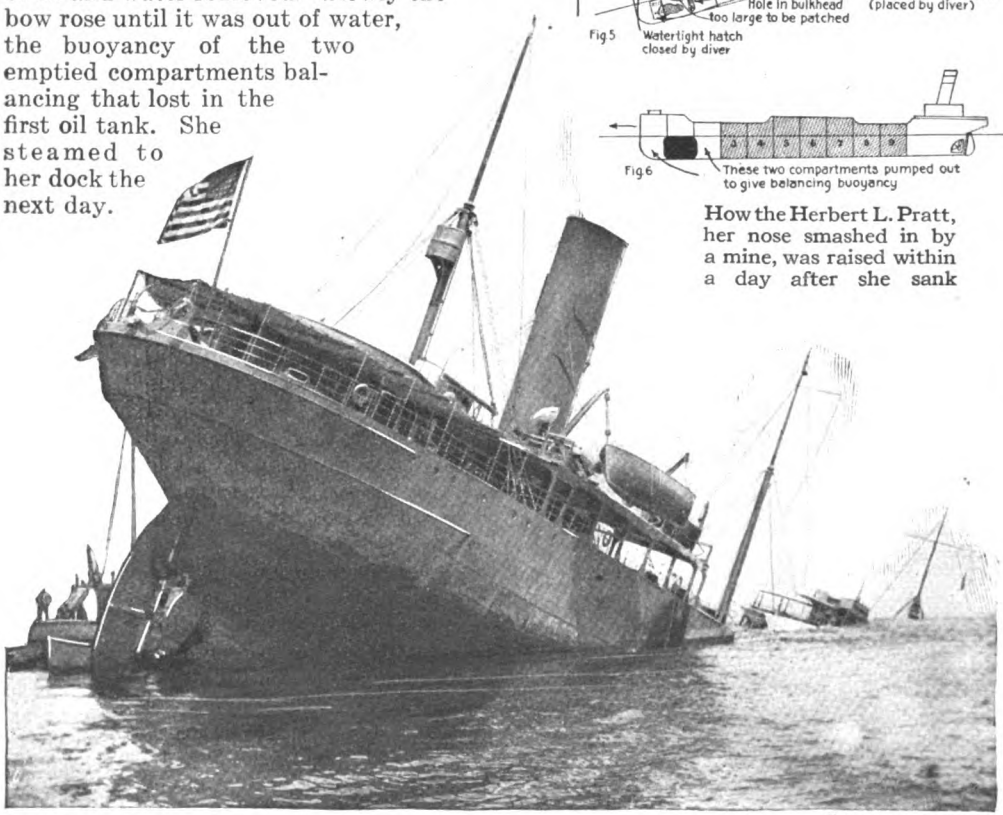
Mined! But She Limped Back to Port

THE oil tanker, *Herbert L. Pratt*, struck a mine on June 2 off the Delaware Capes. It was in all probability a mine "laid" by one of the German submarines that spread terror along our shores. The explosion had punctured four of her eighteen compartments. The uninjured sections kept her afloat, but with her nose in the water.

The hole in the first compartment and that in the centerline bulkhead were too large to be patched, but that in the forecastle and in the transverse bulkhead at the front of the second oil tank were plugged by means of canvas mats which were prevented from being sucked through the holes they covered by short pieces of timbers set in between the twisted bulkhead stiffener angle irons. The watertight deck hatch in the forecastle deck was closed and the pumps started to work. With free water in the first oil tank compartment, the forecastle and second oil tank compartments were pumped and between 8,000 and 10,000 barrels of oil and water removed. Slowly the bow rose until it was out of water, the buoyancy of the two emptied compartments balancing that lost in the first oil tank. She steamed to her dock the next day.



How the Herbert L. Pratt, her nose smashed in by a mine, was raised within a day after she sank



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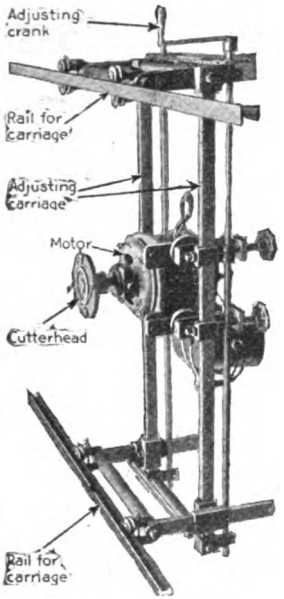
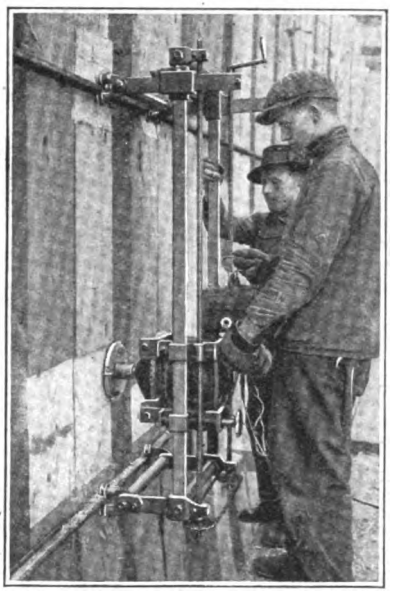




The disk-like rotating cut-head does the work hitherto done by the adz. It can be moved in two directions at right angles to each other. The machine runs on rails which can be bent

in a working day of eight hours. The cost of operating the machine is about $10 a day, counting wages.

The cutting is done by a disk-like rotating head mounted on the shaft of a specially constructed motor which has a speed of 3600 revolutions a minute. The motor is mounted upon two bars which are at right angles to the direction of travel in dressing the surface of the timber. These transverse bars are supported at their ends by arms provided with grooved and ball-bearing wheels. These wheels ride upon T-rails which form a track along which the machine can be moved.

In Which We Tell You What "Dubbing" Means in Shipbuilding

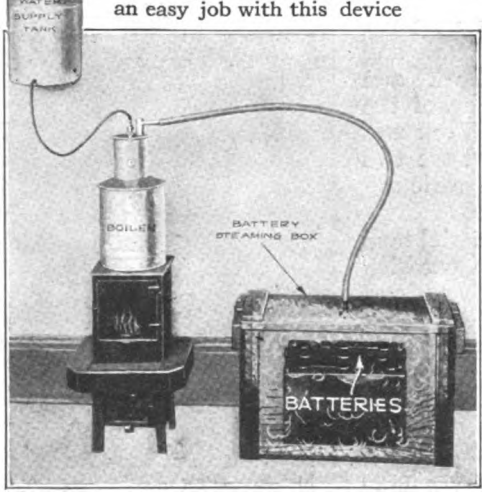
AFTER the framework of a ship in course of construction is completed, the rough timbers must be "dubbed." And that means? Simply that they must be planed snug and smooth before the planking can be put on. Heretofore the work of "dubbing" has been done by hand. Scores of adzmen were employed in every shipyard for that work. The "dubbing" had to be done with great care; otherwise the planks would not fit properly.

A ship carpenter named Clark, in Seattle, recently invented a machine for "dubbing" timber, which will do as much work as forty adze-wielders. And with greater precision. With a single machine one man and a helper can plane from 1500 to 2000 square feet

No More Trouble Getting Inside Your Storage Battery

A NEW device for softening the seals of storage batteries by steam works automatically. A steam generator, a steaming box and a water supply tank are its essential parts. The generator consists of a small cylindrical tank placed over a little gas, oil or gasoline stove. It contains a small float which operates a plunger to close the water-in-take valve as soon as the water reaches a point about three inches from the bottom. In this manner the amount of water in the tank is automatically controlled to remain constant so long as the outside tank is replenished and the mechanic can put a battery in the steam box and leave it without attention while the seals are being softened while he does other work.

Opening batteries becomes an easy job with this device



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Speeding Mail by the Sky Post

The establishment of the aerial mail service between New York and Washington an epoch-making event

When Lieutenant Boyle started on his first mail-carrying trip from Washington, President Wilson wished him the best of luck

FUTURE histories of civilization will make a record of May 15, 1918, as the day marking the beginning of a new epoch in the evolution of the mail service. On that day the service over the first regular aerial mail route, between New York and Washington, with Philadelphia as an intermediate station, was inaugurated. Since then a number of successful flights between the three cities have been made. Notwithstanding a few mishaps the service proved so reliable and efficient that the Government already considers plans for the extension of the sky post by establishing additional routes. Among the lines to be established next are routes between New York and Boston and New York and Chicago. The doubling of the service between New York and Washington, so as to have two trips daily, is also seriously considered.

The opening of the aerial mail service was made the occasion of a ceremony at both ends of the route. Government officials and prominent representatives of the State and municipal governments attended the starting of the airplanes on their initial trips. The War Department had furnished twelve large training airplanes for use in the mail service and detailed several competent flyers from the Aviation Division of the United States Signal Corps. The airplanes placed in the service are built like the army biplanes used for bombing. They are intended to carry only a pilot, so as to give more room for mail. Their carrying capacity is about 300 pounds, but later on airplanes with a capacity of 600 or 700 pounds of mail will be provided.

Lieutenant Torrey H. Webb made the first trip from Belmont Park, New York, to the Bustleton aviation field, Philadelphia, in a Curtiss machine. With 144 pounds of mail, he started at 11.30 o'clock in the forenoon and reached Philadelphia safely at half-past twelve. The mail for Washington was transferred to another airplane piloted by Lieutenant J.

© Photos by International Film Service

Postmaster Patton of New York is shown in this picture handing the mail for Washington to Lieutenant Webb

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Edgerton and arrived at the Polo Grounds of Washington at 2.50 P. M.

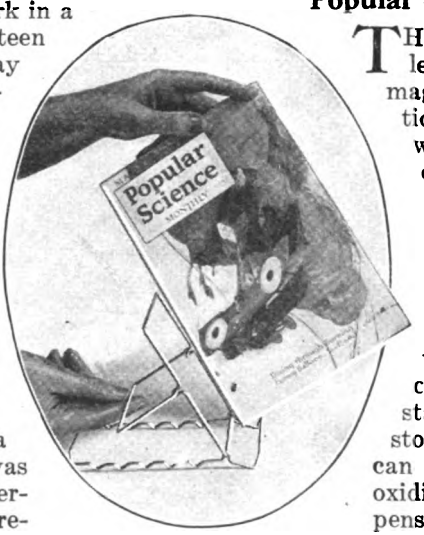
Lieutenant George L. Boyle, who had been selected for the first mail trip from Washington, left the Polo Grounds with 150 pounds of mail at ten minutes before noon. Twenty minutes later he was forced to land at Waldorf, Md., as he had lost his way in the fog. In landing he broke one of his propeller blades, for which reason the mail was taken to Philadelphia by automobile. Without waiting for the arrival of the Washington mail, Lieutenant Howard Culver, with a bundle of 350 letters, started from the Bustleton field at 2.20 P. M. and reached Belmont Park in New York at 3.37 P. M. without mishap.

Lieutenant Webb starting from Belmont Park, New York, on the first aerial mail service trip to Philadelphia at which he arrived in one hour

On the second day of the service Lieutenant Stephen Bonsal, who had started from Belmont Park in a new airplane with seventeen pounds of mail, lost his way in the fog and was compelled to make a landing on the old Bridgeton, N. J., race track. In landing he crashed into a fence and broke the propeller and one of the planes. Again the mail was taken to its destination in an automobile. The north bound relay trip was accomplished successfully. The trip from Washington to Philadelphia with 118 pounds of mail was made by Lieutenant Edgerton. Lieutenant Webb relayed the Washington mail and with five pounds additional mail from Philadelphia reached Belmont Park at 2.58 P. M.

The airplanes used for carrying the mail are capable of a speed of 95 to 100 miles an hour, but for various reasons that speed was never even approached on any trip. Yet, from six to eight hours were gained in comparison with the regular mail service by railroad. It is the intention of the postal authorities to improve the service by using more powerful and swifter airplanes and it is confidently expected that it will be possible to continue the service all the year round. Storms in summer and blizzards in winter may interfere occasionally with the aerial mail and mishaps may not always be avoidable.

This Stand Will Display Your Popular Science Monthly



A stand that shows pictures or magazines to advantage

THE stand shown on the left, for displaying books, magazines, signs and stationery, is collapsible and well adapted to the use of retail dealers. The upright section can be adjusted so as to stand at any one of five different angles in order to get the best light or attract the prospective patron's eye. The collapsible feature of the stand enables it to be stored in a small space. It can be made of tinned or oxidized metal. More expensive ones may be silver-plated or gold-plated according to taste.

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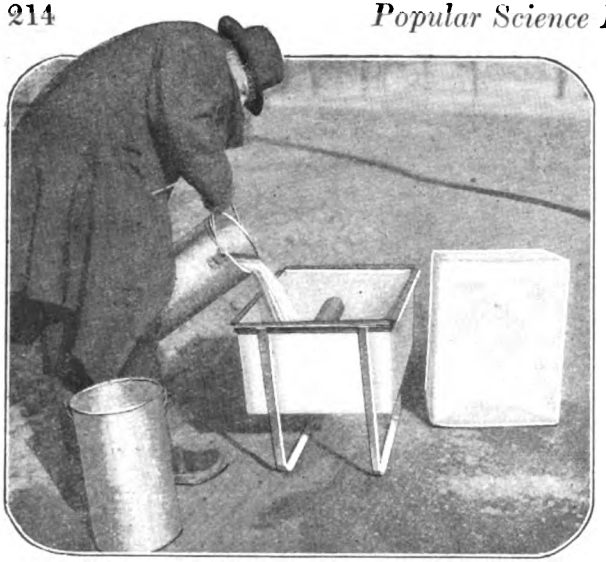

The ice mold, which is operated best in a shady place in the open air

You Need Ice Now? Get Ready for the Harvest

WHERE winters are cold and pure water can be had, any householder can keep himself supplied with wholesome ice all the year round by using a freezing mold of suitable construction and storing the ice in a cool place. A manufacturer in Spokane, Wash., has placed such a freezing mold on the market. Its construction is based upon sound scientific principles. It is so simple that even a boy can use it with success.

The mold consists of a galvanized iron container mounted on strap-iron rockers or shoes and equipped inside with an automatic expansion air chamber. The expansion chamber consists of a water-tight tube. The rubber walls of the chamber are made from a standard size inner tube for automobile tires. The cylindrical ends over which the rubber is drawn are separated by a pipe which passes through one end and thence to the air, down through the bottom of the mold. This pipe has a hole which permits the air to pass out of the chamber when the expanding freezing water compresses the walls. Six spiral springs, stretched from one end piece to the other prevent the tube from caving in under mere water pressure. This expansion chamber is essential, as it prevents the expanding water from bursting the shell of ice already formed.

This mold is intended to mold ice shells from ⅜ of an inch to 2 inches in thickness, not to freeze solid cakes of ice. After the shell is frozen, which takes from 2½ to 9 hours according to the outside temperature, the shell is slipped out of the mold and filled with water which is then allowed to freeze to form a solid cake. To keep the water at the bottom of the mold from freezing the bottom is made of a board, which is separated from the metal by a layer of cork or fiber felt. When the mold is turned upside down and the ice shell slipped out, the shell will be found open at the top. After it has been filled with water, the opening is closed with a cover, consisting of wire screening in a wooden frame and covered with burlap or canvas.

How a Chautauqua lecturer could moralize on the tree that seeks to burst the bounds of the wheel!

Wheel and Tree Puzzle

A FARMER rolled an old wagon wheel into a corner of the lot. It lay hidden amid weeds and débris. In the course of time a tiny tree started to grow between two of the spokes and grew so big that it broke one of the spokes from the rim and threatens to break another. The puzzle: separate wheel and tree.

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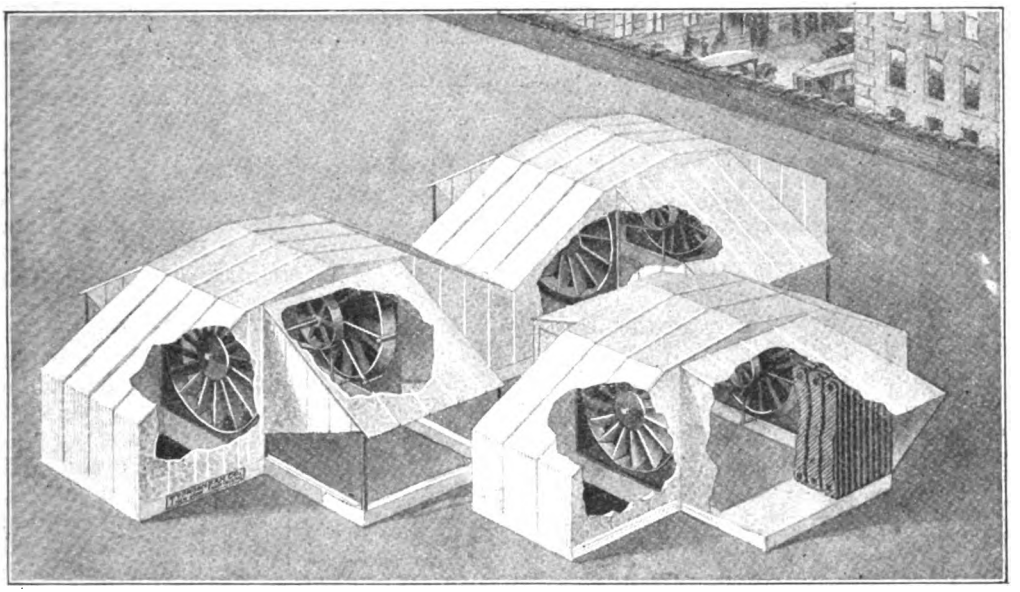


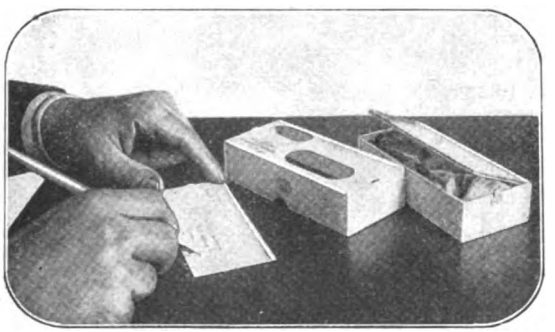
One or two of these fans suffice for the average hall, for very large halls more fans are required. They demonstrate the fact that one may be comfortable though in mid-summer

"Ten Degrees Cooler Than Outside." And It's True, Too!

ON a hot summer day even the most persuasive barker or press agent will find it difficult to convince the public that they will find it pleasant and cool in his theater. But the person who feels a pleasantly cool draft coming from the open door of the theater when he passes will be convinced and ready to go to the box-office for a ticket. One or two blowers placed on the roof of the building or in some other convenient place and so arranged that they draw comparatively dust-free air and force it through suitably provided openings into the auditorium are all that is needed to produce a circulation of air in the hottest and stuffiest hall. The cool, fresh breeze from the outside, which is pumped into the hall, displaces the hot and stagnant air contained therein and, if the precaution is taken to arrange the openings for the admission of the fresh air above the heads of the spectators, all disagreeable drafts are avoided. A New York manufacturing concern is making them.

Don't Throw Away the Box. Use It for Remailing

REMAILING by means of the same box in which an article is sent is rendered convenient by a mailing box that has a transparent opening for the address of the sender and another for the address of the receiver. Cards bearing the addresses can easily be reversed so that the box may be prepared for remailing. The words "To" and "From" are on the transparencies and not on the cards themselves. One box can, of course, be used a number of times, cards being inserted for the different addresses and removed at will.



It has two transparent openings—one for the sender's address and the other for the receiver's

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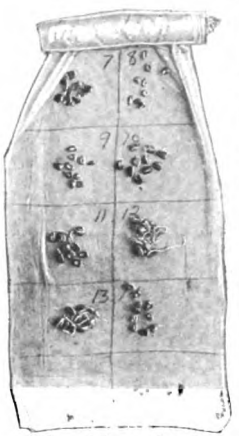
Test Seed Corn with a "Rag Doll"

A simple, homemade device recommended by Department of Agriculture to the farmer

The rag doll corn tester as it looks when all prepared for the work of testing grains of seed corn

DEFECTIVE seed corn means a loss of millions to the United States annually. Clearly some method ought to be adopted to ascertain whether or not seed corn will germinate. The Bureau of Plant Industry of the Department of Agriculture is doing its best to encourage the use of the "rag doll" tester—a device which can be made at home. Here are the directions:

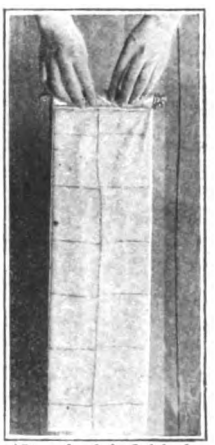
Cut bleached muslin into strips sixteen inches wide and from three to five inches long. Leaving a margin of four inches at the ends, mark the strip crosswise every four inches. Number the sections.



The bleached muslin is marked off in squares

Number the ears to be tested and place them in systematic order. Dampen the tester. From different places on ear 1 take out ten kernels and place them in section 1. In a similar manner, take ten kernels from ear 2, place them in section 2. Continue until every section of the tester has been filled.

Place the kernels some distance from the dividing lines, so that the samples will not be mixed in handling the tester. Fold each side of the tester over so that the edges meet in the middle, as shown in one of the illustrations. Press the cloth down securely over the kernels. Using a corncob as a core, roll the tester up. Tie a cord or slip a rubber band around the middle. The job of manufacturing the doll is complete.



The cloth is folded once, then rolled up around a cob

Now the process of germination begins. The doll is soaked in lukewarm water from two to four hours, with ten hours as the maximum. Then it is removed from the water, permitted to drain, and placed in a warm, moist spot. During the germination period the doll should not be subjected to a temperature higher than one hundred or lower than fifty degrees Fahrenheit.

Don't souse the doll a second time. To prevent its drying out, wrap it in a piece of wet sacking or stand it upright in a water bucket, covered with a wet cloth. Excess moisture should be drained off. At the end of five days the sound kernels should have sprouted sufficiently to differentiate them from faulty seed. Seed dealers and their traveling agents are offering many kinds of seed-testing apparatus but the home-manufactured device, as outlined above, has all the virtues of the commercial product, without its fancy price. The Bureau of Plant Industry of the United States Department of Agriculture has only lately checked up the merits and demerits of the rag-doll seed tester and finds it entirely satisfactory.

Wrap dolls in wet sacking or stand them upright in water bucket covered with wet cloth to avoid drying

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Studying Trench Warfare with the Aid of an Intricate Model

THE art of constructing entrenchments has become a science of hitherto undreamed of possibilities. Never before was trench war conducted on such a large scale. Its development, influenced by modern improvements and changes in weapons, tactics, and conditions, has become so intricate that a special course of study, embodying the principles and endless details of trench fighting had to be devised for the officers and non-commissioned officers who are to enter service at the front. The accompanying picture shows how the non-commissioned officers in training at Camp Grant, Ill., are taught the intricacies of modern trench warfare by means of a model representing the most advanced ideas of trench construction as practised by the French engineers on the West front.

A model of a modern trench system looks like a picture puzzle; but each kink and twist has a meaning of its own

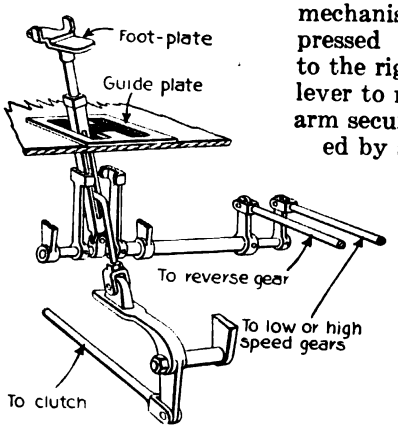
The trench-lines of the sector shown seem like a picture puzzle. Their apparently artless irregularity is not a matter of chance. It is based upon sound scientific principles, and there is a good reason for every kink and twist. The different features of trench fighting must be studied in detail.

A Foot Operates the Clutch and Gear-Shifting Mechanism

THE clutch pedal and the gear-shifting mechanism have been so combined by E. R. Martino that the clutch will always be out during the shifting of the gears.

Attached to the pedal is a rod extending through a pivoted tubular lever. Through a slot in the hollow lever runs an elbow rod which has a pivoted shoe resting on a rod controlling the clutch. When the driver presses the pedal downward with his foot the shoe moves correspondingly, operating the rod attached to the clutch and throwing it out. The pedal, after it has been relieved of the foot pressure, returns to its former position, and a spring throws the clutch in again.

In order to adjust the speed mechanism the pedal is depressed and moved sideways to the right, causing the hollow lever to rest in a socket on an arm secured to a shaft connected by a lever with the speed gears. Then the pedal is released, throwing in the clutch, and moved forward or backward, according to the speed desired. Reversal of the automobile is brought about by pressing down the pedal and then throwing it to the left and forward.



The clutch will always be out while the gears are being shifted

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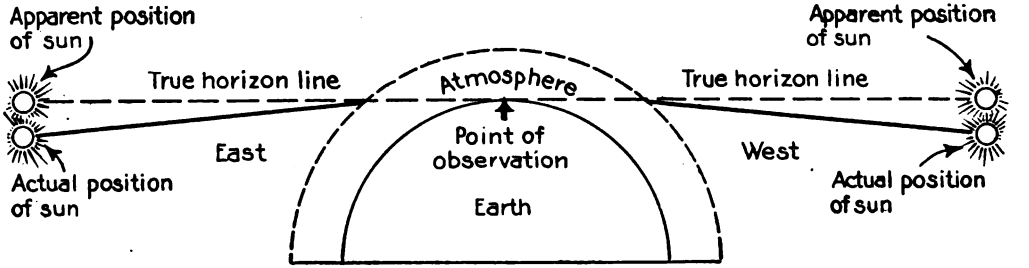


Because its rays are bent by the atmosphere, the sun appears to rise or to set when it is really below the horizon. A study of this diagram will make this clear to the reader

The Sun Really Rises After We See It Rise. Why?

HAS it ever occurred to you that we never see our Sun either rise or set? When it seems to rise or when it seems to set it is below the horizon.

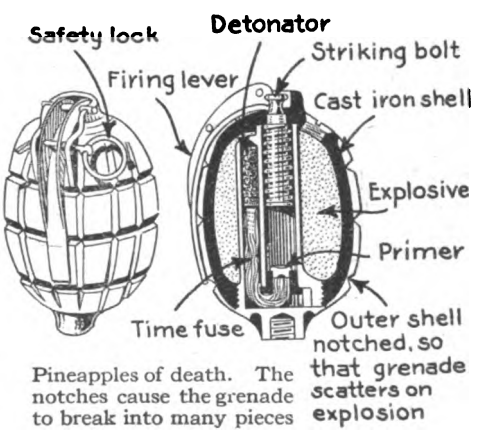
These statements are absolutely true. Our eyes do not deceive us, but the atmosphere does. It possesses a quality of refracting or changing the direction of the Sun's rays. These rays enter our Earth's atmosphere, at sunrise or sunset, obliquely, and then instead of proceeding in a straight line they are so bent out of their natural course that the Sun's rays reach us before he begins to appear above the eastern horizon and after it has wholly disappeared below the western horizon. In other words, our Sun really rises after we have seen it rise and really sets before we have seen it set.

How the Deadly Mills Hand Grenade Is Made and Exploded

THE grenades which are used by the French and allied troops at the West front are of the type invented by William Mills, an Englishman.

The grenades of the Mills type are egg-shaped, about four inches long and nearly three inches in diameter. The outside shell is of cast iron and deeply notched. The fuse and the ignition device are enclosed in a separate tube which is inserted into the outer shell and secured by a screw thread at one end.

The inner core consists of two parallel tubes connected by a U. In the wider of the two tubes is a plunger or striking bolt surrounded by a spiral spring which has the tendency to press the bolt against the ignition cap. The bolt is drawn away from the cap by overcoming the pressure of the spring and is held back by a trigger or firing lever locked securely by a pin to which a ring is attached. When the grenade is to be used, the locking pin holding the firing lever is pulled out, and the man clasps his hand around the shell, to prevent the lever from moving. When the grenade is thrown, the firing lever under pressure of the spring around the striking bolt flies up, releasing the bolt, which is flung down upon the ignition cap by the action of the spring. The cap explodes and ignites the time fuse, a slow-burning powder, which communicates with the detonator in the upper end of the narrower part of the U. The detonator causes the lyddite or other powerful explosive with which the grenade is loaded, to explode. The grenades now used by our allies may differ in small details, but the main features are alike in all. There is a good reason for the deep notching of the outer shell. It is that when exploded the grenade may break into many pieces.



Pineapples of death. The notches cause the grenade to break into many pieces

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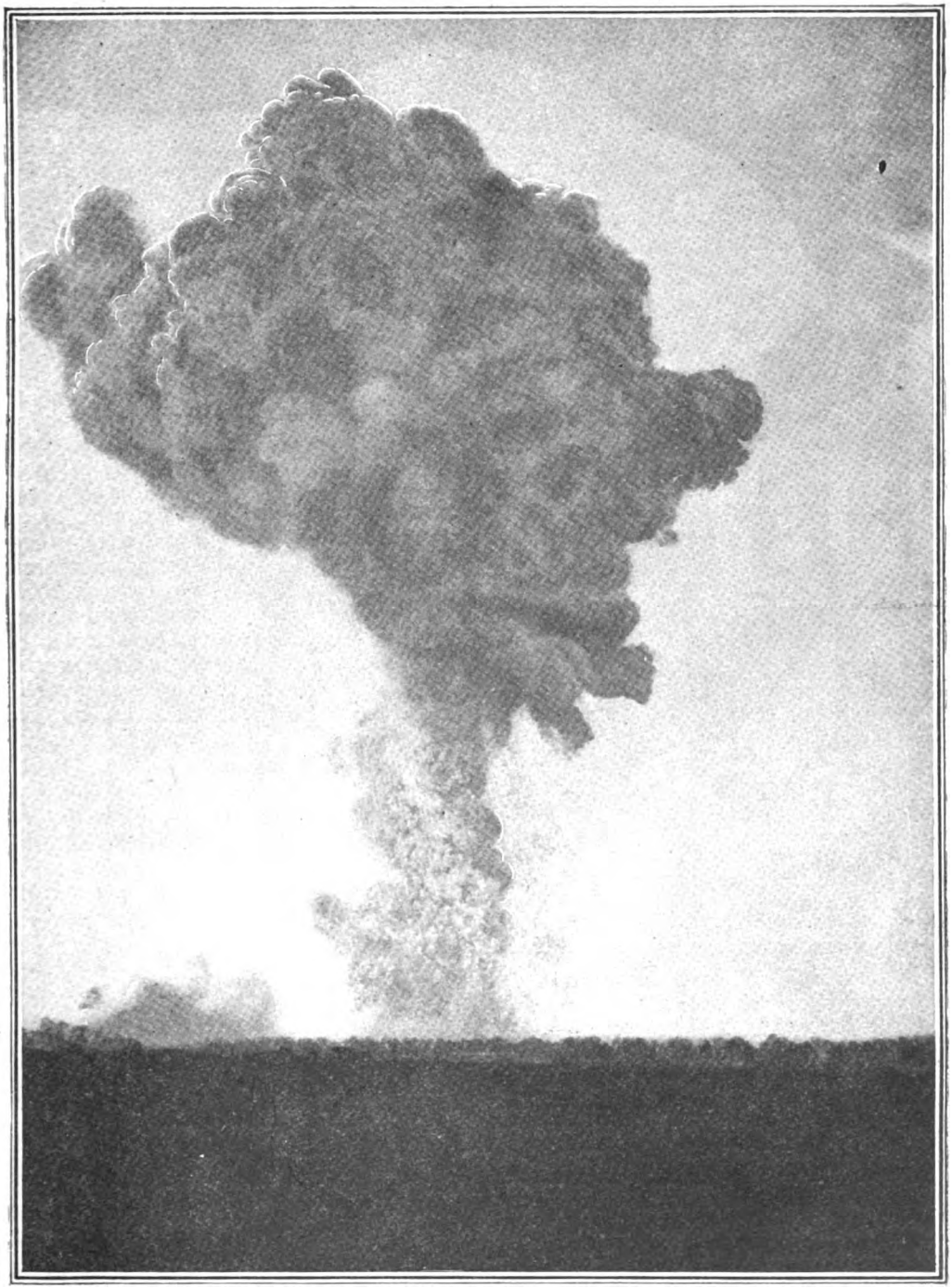
When Fifteen Million Grenades Exploded



Shortly before two o'clock on a recent afternoon all Paris shook. A few moments later the terrified populace saw a gigantic column of smoke rise to a great height like the cloud of dust and smoke sent up from an active volcano. What was it? Fifteen million hand grenades had exploded at Courneuve, outside of Paris. Residences and factories were destroyed or damaged for a distance of thirty miles; more than thirty people were killed, and hundreds injured by the explosion

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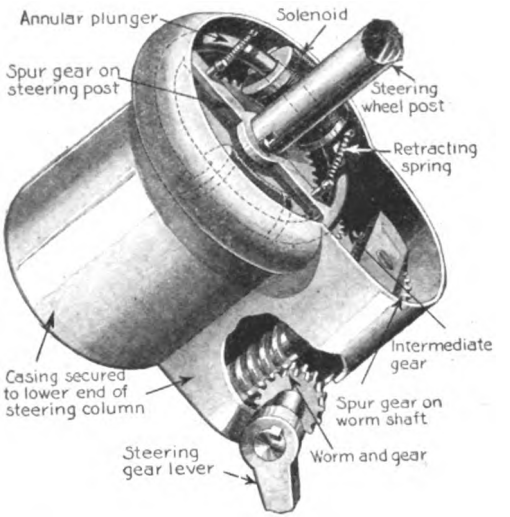
A Push Button Works the Steering Gear

The second prize in the Popular Science Monthly's automobile labor-saving contest was won by this electrical steering control

THE winner of the second prize in the POPULAR SCIENCE contest for the best labor-saving automobile device (the conditions were published in the April issue), devised an electrically-operated and controlled automobile steering wheel, which is operated by a mere push of a button switch in almost the same manner as you would turn on and off an electric light in your home.

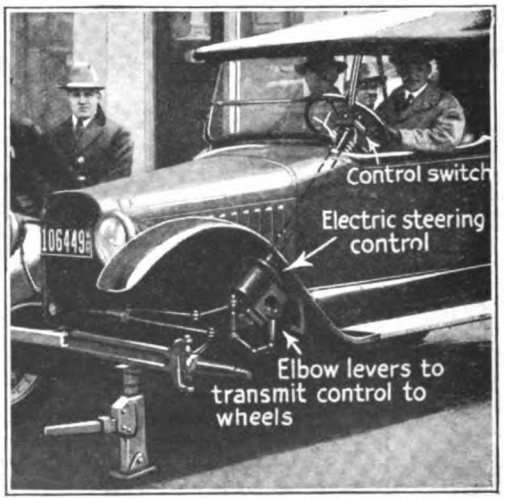
P. C. Haas, of 420 South Division Street, Ann Arbor, Mich., the second prize winner, uses two solenoids with plungers connected up with an arm on the steering-post column. By varying the amount of current passed through the solenoids, the pull on the plungers is varied to turn the arm and with it the steering column in much the same manner as the traces of a horse pull the ends of a whiffletree. This principle is clearly shown in the line drawing given on this page.



The electrical steering control and how it guides the car

In its application to the automobile, however, the principle is worked out somewhat differently for the sake of adaptability and to take up the least space possible. As shown in the perspective illustration, the device is made up into a cylindrical case attached to the bottom of the steering post column. At opposite points inside the casing are two curved solenoids, through the centers of which is inserted an annular plunger pivoted to the steering shaft. Variable resistance coils, enclosed in a small case, are carried in some convenient place on the automobile. To each of the two solenoid circuits one of the resistance coils is wired. When the resistances are the same, the current passing through the solenoids exerts an equal pull on the plungers attached to the steering arm so that the wheel is held in its normal and straight-ahead position. If the resistance of one solenoid is diminished the balance is disturbed and the other solenoid will exert a pull on the arm, thereby turning the steering post and the front wheels. By manipulating the resistances the car may be steered just the same as by hand. A train of three gears transmits the motion of the steering post to the steering crank and to the cross rod attached to the steering knuckles on the wheels.

The attachment of the electrical



The steering wheel is used only when the electrical control refuses to work

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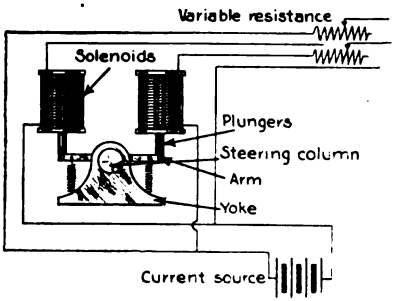

The wiring would be practically the same with ring-shaped plungers

steerer does not interfere with steering the car by hand in the usual way. The regular steering wheel is left in its place both for looks and as a means of steering in an emergency, should the electrical steerer become inoperative at any time.

The invention is interesting because it is in such perfect accord with the modern tendency of automobile inventions to promote efficiency and at the same time save man-power by making machines and mechanical devices do as much as possible the physical labor heretofore done by human or animal muscular power.

The vacuum cleaner can do its task quickly and thoroughly so long as the machine runs

Sucking Dust and Lint from Moving Machinery

THE constant and rapid accumulation of dust and lint on and in the machinery has always been one of the most vexing problems in spinning and textile mills. Small particles of wool, cotton, linen or some other fiber become detached from the yarns and threads during the spinning or weaving operations. The drafts produced by the moving machinery and other disturbing influences carry these small particles in every direction, and the whole air in such mills becomes filled with dust and lint. The presence of these impurities in the air is highly objectionable. It endangers the health of the employes and clogs the delicate machinery.

The workers in the mill can protect themselves by using respirators or any simple air filter. But to prevent the machinery from becoming clogged it must be cleaned from time to time and the cleaning, to be effective, must be thorough. All that takes time and labor and reduces the productivity of the mill. The invention of the vacuum cleaner has been a great boon to the textile mills. It has made it possible to remove the dust and lint from practically every part of the machinery more thoroughly, in a shorter time and without stopping the work for hours at a time. All this means greater efficiency, a saving of time and money and, incidentally, a diminution of the fire risk, because the lint does not collect and become soaked with oil, a condition in which it is subject to spontaneous combustion.

Maybe you have special needs. Write to the editor about anything within the scope of the magazine. He will be glad to help you.

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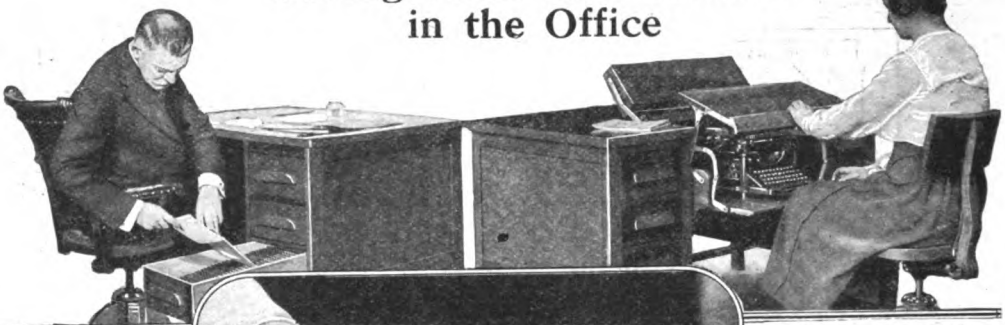
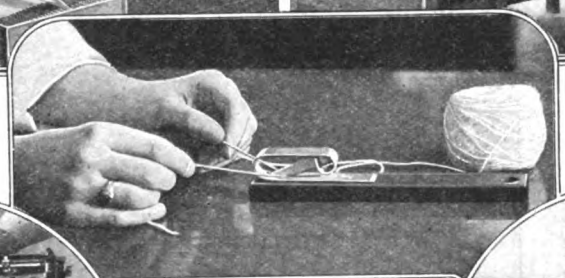
Saving Time and Trouble in the Office

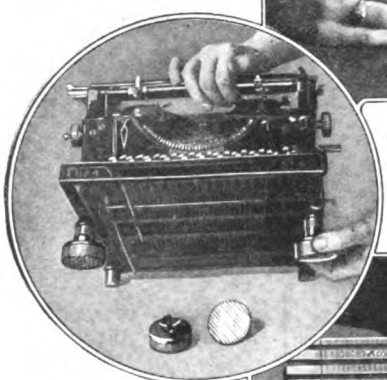


Drawers of filing desk are fitted with accessible pockets which are labeled

This typewriter desk has a light, springless table for the typewriting machine

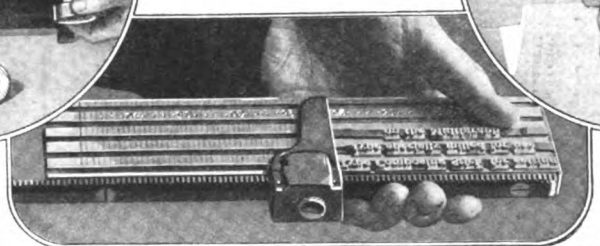


Cord-cutter that may be placed on a counter or hung on a wall near the package wrapping table

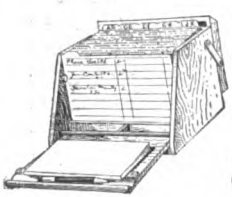


An efficient pad for the typewriter feet to prevent creeping as well as noise

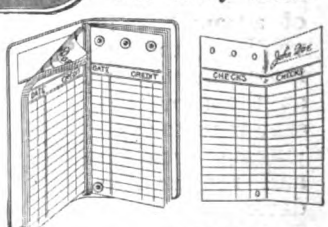
Problems in designing reinforced concrete solved with this handy device



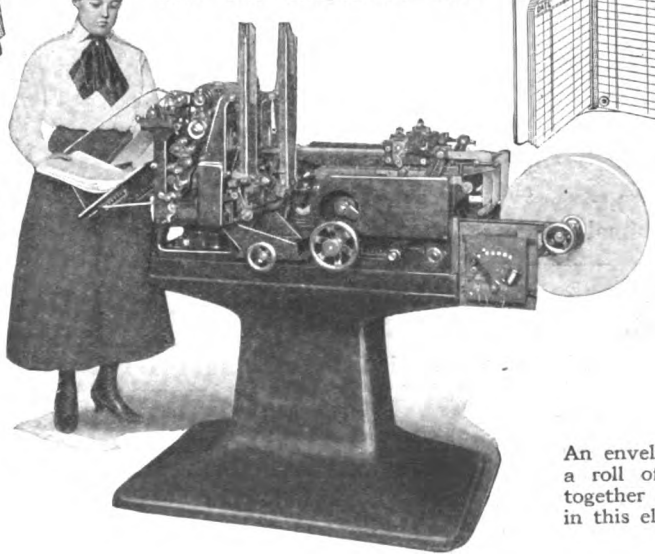
The slow and laborious setting of multigraph type is reduced with this compositor's stick



Handy desk reminder in which cards automatically present themselves as the calendar cards are removed every day



A loose-leaf bank pass book in which the leaves may be removed from the cover and placed in an adding machine



An envelope is cut from a roll of paper, pasted together and addressed in this elaborate machine

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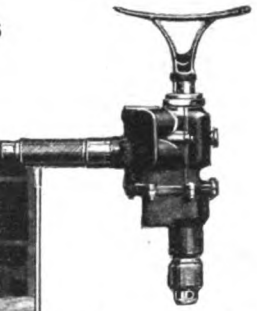
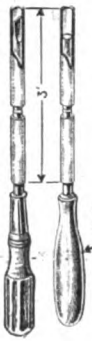
Do It with Tools and Machines

A very neat and durable tool box for mechanics, which is made of sheet metal and is enameled

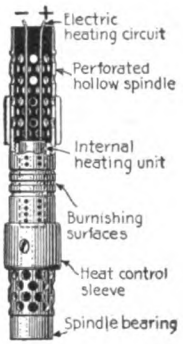
Tedious task of hand rubbing to finish surfaces is displaced by this electric machine



Pneumatic drill especially adapted for use in garages

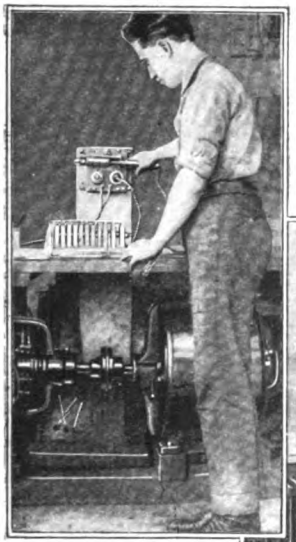


Screwdriver and hammer with long handle extensions for overhead work

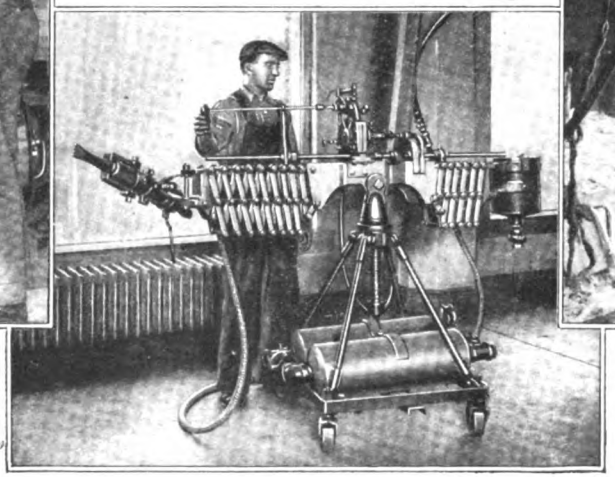


This tool has a revolving spindle for burnishing leather

Pigeon holes for the shop to hold nuts, bolts, screws and small parts, are shown in the center



He is soldering with electricity, having soldering-iron holder



A drilling machine outfit with lazy-tong arms. Storage tanks are used to maintain pressure

Here's the pneumatic calking machine for rapid work on ship hulls

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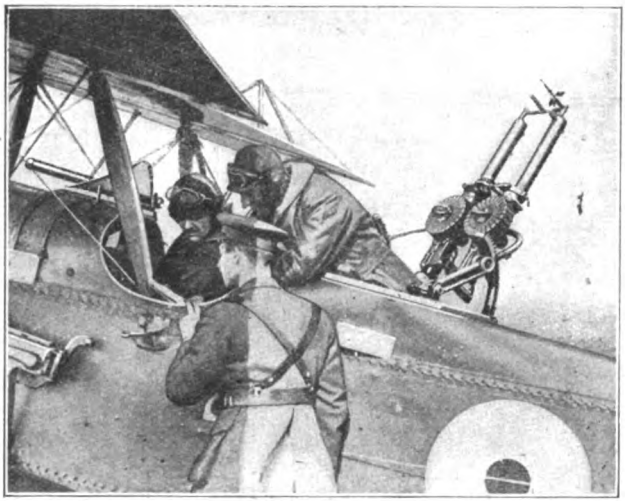


© Underwood and Underwood

No wonder they call them "binocular" machine-guns. When mounted, don't they look like field glasses?

Like Opera-Glasses—That's How Guns Are Mounted on Planes

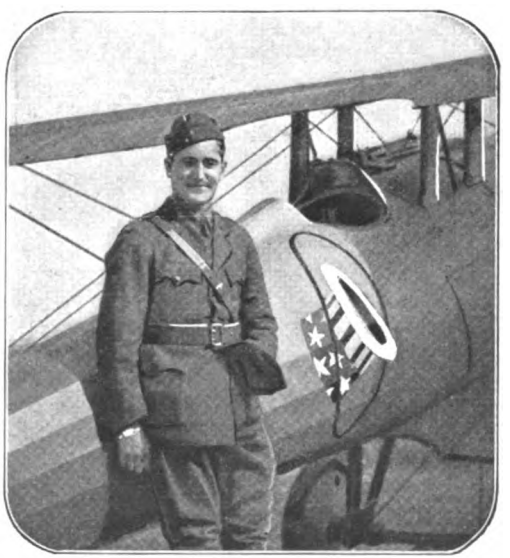
WHEN the airplane was first introduced as an adjunct to warfare it fulfilled not even theoretically the requirements of a weapon of attack or defence. Experience proved an efficient teacher and under the stimulating influence of necessity the development of the military airplane progressed with remarkable rapidity.

One of the most striking evidences of growing maturity is presented by the fact that the armament of modern military airplanes no longer bears the character of an improvisation, but is constructed and mounted for a definite purpose and in conformity with the technical requirements of just such a fighting machine.

The new twin guns, known as "binocular" machine guns, which are shown in the accompanying picture, show no trace of being improvised. They are unmistakably constructed and mounted for aerial use and every detail of their construction was suggested by previous experience. An excellent feature is the circular magazines, which are far superior to the old cartridge belts because they interfere less with the rapid swiveling of the guns.

Uncle Sam's Hat Is in the Ring—and Winslow's Airplane Proves It

LIEUTENANT ALLAN F. WINSLOW of Chicago will go down in history. He is the American who brought down the first German flying machine credited to our Expeditionary Force. The insignia seen on the side of the flying machine shown in the accompanying photograph eloquently conveys the idea that Uncle Sam's hat is not only in the ring but that it dominates the ring exclusively. This will be demonstrated more and more conclusively as our aircraft construction program progresses from day to day.



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Lieutenant Allan F. Winslow of Chicago and the flying machine in which he brought down a German airplane

Those of us interested in science, engineering, invention form a kind of guild. We should help one another. All the specialized knowledge and information of the editorial staff of the Popular Science Monthly is at your disposal. Write to the editor if you think he can help you. He is willing to answer questions.

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Making a Sport of Grenade-Throwing

The grenades are like those used in the trenches—without the explosives

HAND-GRENADE throwing, conceived in the stress of war, born in the trenches through necessity and developed to the point of a fine art by constant practice, has been taken up as a sport far from the maddening din of battle and is rapidly gaining in public favor. The grenades used in the sport are made of cast iron and weigh exactly twenty-two ounces each, just like the real hand-grenades used in trench warfare, but minus the explosives.

To aim a hand-grenade correctly is not quite so simple as one may think. To throw the grenade successfully the thrower must learn the carefully worked-out style of delivery which utilizes all the muscles of the body and puts the full force of the body behind the throw without laming the arm. The grenade is too heavy to be pitched like a baseball.

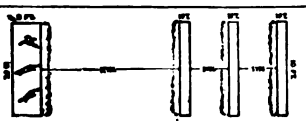
You throw the grenade by rocking the whole body—not like a baseball

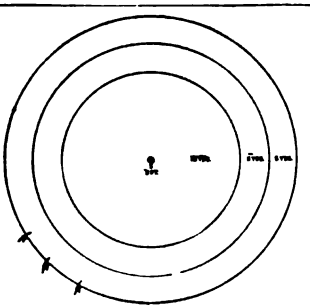
The position of the soldier in the picture is that immediately preceding the throw. In delivering the grenade the right knee is straightened, the whole body swung forward and, while the extended left arm is swung down and to the rear, the right arm describes an arc toward the front, throwing the grenade over the head. The muscles of the legs, the arms and of the body coordinate their efforts in this throw, but it requires some practice to become proficient in this style of delivery.

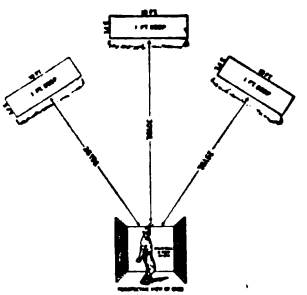
The three diagrams illustrate the method adopted by the United States Army to make hand-grenade throwers proficient. The simplest consists of a throwing trench about one foot deep, three feet wide and ten feet long. Fifteen yards directly in front of this trench is another trench 10 feet long, one foot wide and one foot deep. At twenty yards and also at twenty-five yards similar trenches are constructed. For the next step in the training the circular arrangement is used.

Around a "bull's eye" of three feet diameter three concentric circles are drawn at 15, 20 and 25 yards from the center. The men are placed at suitable distances from one another—first on the 15-yard line and, as their proficiency justifies it, on the more distant lines.

For the final test an arrangement like that shown in the third diagram is used and practice is allowed therein.







These diagrams show the successive steps in the training of an American soldier in the art of hand-grenade throwing. A good thrower is able to hurl ten out of fifteen grenades into each trench

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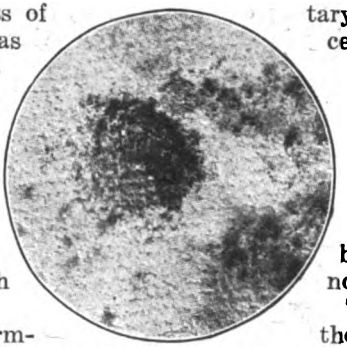
Like a Duck's Back

Proofing the cloth used for war purposes against water and mildew

By John Walker Harrington

TENTS and uniforms for the army must be proof against both moisture and mildew. These are days in which the dampness of trench and dugout, as well as the rains and the snows, plays havoc with materials and fabrics. Shoes that have been brought back are moldy; a greenish coating clings to them, composed of minute plants—the malignant microbes which cause the disease known as "trench foot."

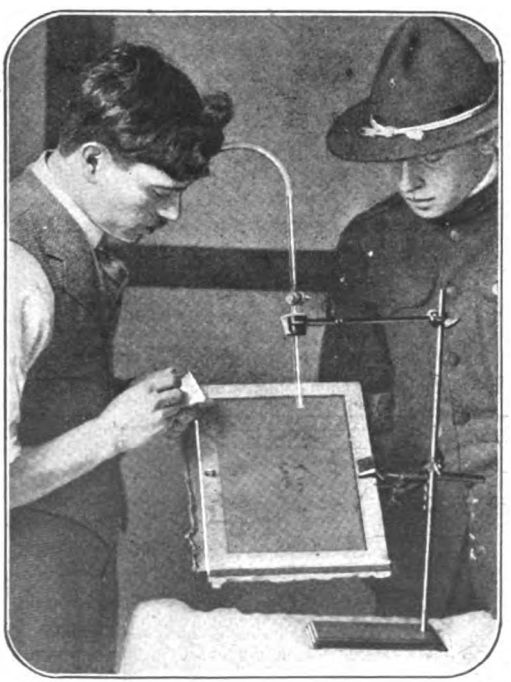


Sample of mildew growth one month after inoculation and incubation

The various mildews or harmful molds are composed of tiny enemies of mankind. Unless equipment is made as near proof against them as possible disease will result. The Bureau of Chemistry of the Department of Agriculture has been assisting the War Department in devising protection for all kinds of fabrics used for military purposes. At the recent Textile Exhibition, held at the Grand Central Palace in New York City, a well-known biologist and chemist representing the Bureau of Chemistry, demonstrated a novel method by which it can be ascertained whether or not a fabric will mildew.

The first step is to obtain the seeds or the spores of the small organisms which cause mildew.

A small piece of spoiled fabric, taken either from a tent or a molded tarpaulin, contains myriads of the spores. They are separated from the cloth and spread upon a small quantity of jelly made from Japanese seaweed agar-agar or from Iceland moss. This jelly is mixed with highly nutritive substances which are just as agreeable to the bacteria as they would be to a boy who is fond of jelly-like desserts. In this rich medium the molds grow rapidly, and millions of the mildew spores are developed.



Testing tent canvas to determine whether it will shed water running over it or not

Killing Mildew with Copper Salts

On top of the layer of the nutrient agar jelly has been laid a small disk of the cloth to be tested. If this sample has not been properly protected, the mildew will soon attack it. The chemical treatment of cloth which the spores dislike most of all is a cupro-ammonium treatment, frequently called the Willesden process, which is commonly employed in England. This powerful copper salt clings to the very fibers of a fabric and gives it a light greenish color, which is often disguised by the addition of brown, khaki or any other dye. Specimens of cotton duck treated in this

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manner have withstood the attacks of the hostile legions of mildew and bacteria without the loss of a single fiber.

As tents, uniforms and all cloths must withstand considerable moisture, the chemicals used to protect them against mildew must remain in the mesh. Before the Government experts throw the textile Daniel into the glass den of the ravening bacteria they wash it thoroughly in clear water. The rinsing process takes out carbolic acid or any other readily soluble germicidal chemicals. This preliminary test is the equivalent of one good drenching.

Scraping mildew germs from an infected tent canvas to make a test of their rapidity of growth

It does not take very long for the destructive effects of the mildew to become evident. Little colonies form on the surface of the sample, and if the cloth is poorly protected, they will have practically destroyed it before the expiration of thirty days, assigned to the test. Even if the damage appears to be slight, the fabric has frequently been so weakened that if it were used in a tent the water would soon be leaking through the affected places. Some of the specimens inoculated in the Government laboratories look worse than shreds of mummy cloth taken from the tombs of the Pharaohs.

Manufacturers who saw these exhibits and especially the horrible examples, arranged for a select line of mildew tests of their own to be made in their establishments before sending their goods to the Bureau of Chemistry to be passed upon for Government contracts. As a result of this activity all kinds of cloth are already being standardized. This saves a great deal of time for all concerned.

Inoculating the agar-agar jelly with mildew germs from canvas

It is very essential that a tent should withstand moisture; for the Government buys nothing but waterproof canvas. Resistance to water must be obtained by virtue of the weave of the fabric itself. It cannot rest upon sizing or the introduction of undesirable foreign substances into the texture. The Federal experts take a large square of the material to be tested and make it into a conical bag. On the outside of it they place a paper filter and then put the two into a glass funnel. The funnel is supported by the iron ring of a filter rack. It is then filled with water and the surface of the fluid is maintained at the same level by a supply of water contained in a bottle which is turned upside down over the top of the funnel. Cloth is a hundred per cent. water-resistant if after five days of this test no moisture has seeped through it and no trace of dampness is to be seen on the sensitive outside filter of paper.

Will This Tent-Cloth Stand Water?

Under the spout of the funnel is a graduated glass cylinder in which the amount of water passing through a sample may be accurately measured. In some grades of canvas the Government will accept goods through which there is a slight leakage under these test conditions.

From a tent the water is supposed to run as easily as it slides from the back of a duck. In order to make sure the examiners

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attach a square foot of the cloth undergoing the test to a wooden frame. Underneath the fabric is a layer of highly absorbent paper. The frame is slanted at about the angle of a tent flap. There is then placed over the sample a small glass tube which is connected with a tank of water. By means of a glass faucet the flow of water is so regulated that it comes in a stream delivering a definite amount in a given time. The fabric which undergoes this ordeal without absorbing moisture for six days, may be regarded as a very effective protection against the elements.

If the water doesn't seep through, the canvas is good

Arrangements are also made for subjecting samples to a continuous downpour of water equivalent to a tropical rain storm. Specimens are also actually exposed to the weather for long periods so that the effects may be reckoned for service conditions.

In addition to the tests which have been here described, the Government also subjects the yarns and threads of the various fabrics to elaborate examination to determine their tensile strength.

By the time textiles are ready to be made into tents, uniforms and equipment they may be considered as above suspicion.

The Mysteries of Liquid Fire Are Explained

A LIQUID fire apparatus usually consists of a metal tank holding about four gallons of liquid to be burned, a section of pipe from this tank to a rubber hose at the other end, in which there is a smaller metal pipe about a yard long fitted with a nozzle, and a friction igniter, as well as an oil burning wick. There is a valve near the tank and another near the nozzle. Benzol, from coal tar, and crude oil, are used in equal proportions and are carried in the tank under a pressure of approximately three hundred pounds per square inch, this pressure being maintained by compressed nitrogen, an inert gas having no effect upon the contents of the tank. The tank and accessories are carried by one man, while the nozzle is carried by a companion when liquid fire is being burned.

In use a cap is drawn from the end of the nozzle and a wick burning kerosene or similar oil is thereby lighted, since the cap is a friction igniter. The oil is then turned on and is ignited as it leaves the nozzle under great pressure. The result is a flame of burning oil about thirty yards long. For two-thirds of this distance the flame is straight, but it then turns up as does any other flame. The flame may be directed against the ground, but care must be taken not to deflect it too sharply as it may strike the ground and turn back toward those operating the device. It is therefore not well suited to turning down into a trench.

It is claimed by an expert from the American Chemical Society that liquid fire is not so effective a weapon now that it is understood by the troops and means for defense have been worked out. It can be readily understood, however, that a number of such devices, with the roar of the escaping oil, when used together, give a means of demoralizing the defenders of a trench, especially at night, and in the beginning was a valuable accessory weapon of offense, especially for raiding parties.
—H. E. Howe.

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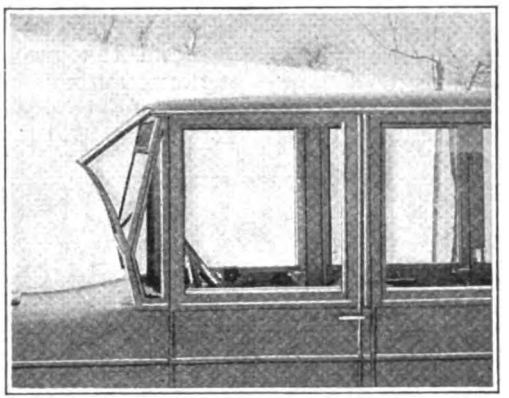
Windshield and Sunshade in One. It Works with a Twist of the Wrist

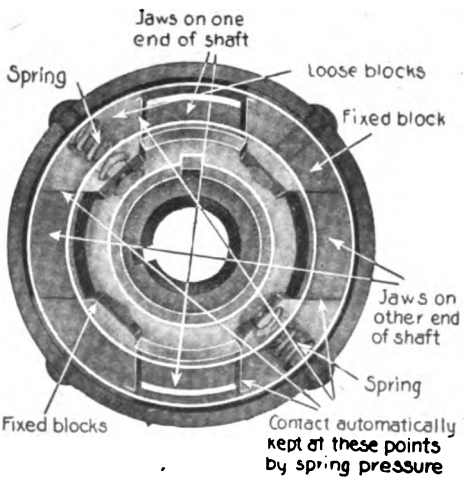
A NEW windshield slides upward by means of two threaded bars, one on each side. Its advantages over the ordinary shield hinged at the top are obvious. When it is desired to open the windshield for fresh air or clear vision, it is pushed up only as far as needed, whereas the shield hinged at top, in order to obtain, say, two inches of open space, would manifestly require to be pushed outward a great deal further than that, thereby letting in rain or wind or snow. This new type of windshield is also provided with a canvas awning serving as a sunshade.



The windshield slides upward and it has a canvas sunshade slanting outward at top

Taking Up the Wear in a Magneto Coupling by Means of Springs

IN driving water pumps and magnetos on automobile engines, it is necessary to provide some method of compensation for any possible misalinement of the pump or magneto shafts with the driving shafts. While the usual type of two meshing jaw-clutch ends has given good results it wears away because of the metal to metal contact and becomes a noisy consumer of power. To eliminate these difficulties, the new type of coupling shown in the accompanying illustration is provided with two loose triangular-shaped jaw members carried on springs extending through the circumferential band holding the jaws in place. Because of the pressure exerted by the springs, the loose jaws hug the fixed ones and automatically take up any wear between the two parts.



Because of the pressure exerted by the springs, the loose jaws of the magneto coupling automatically take up the wear

How to Make an Old Car Pay

THE experience of an automobile owner, as told by himself in a magazine devoted to automobiling, should be of particular interest at the present time to owners of old cars. The man in question, a farmer in Ohio, had bought a touring car in 1910 and had used it five years. He tried to trade in his old car as part payment on a new car, but he could not obtain the conditions to which he considered himself entitled. He purchased the new car outright and kept the old one. He converted it, at small cost, into a truck which has given him good service ever since. Every day he takes the milk from his dairy to the city and on the return trip brings feed and supplies back to the farm. He also uses the car a great deal for business trips connected with his farm work. He also purchased special tractor wheels and used the old car as a tractor for plowing. He found that it saved him time, labor and expense. Seeing that he could do without horses, he sold the three he had at a good profit for more than the car cost him and saved on their feed.

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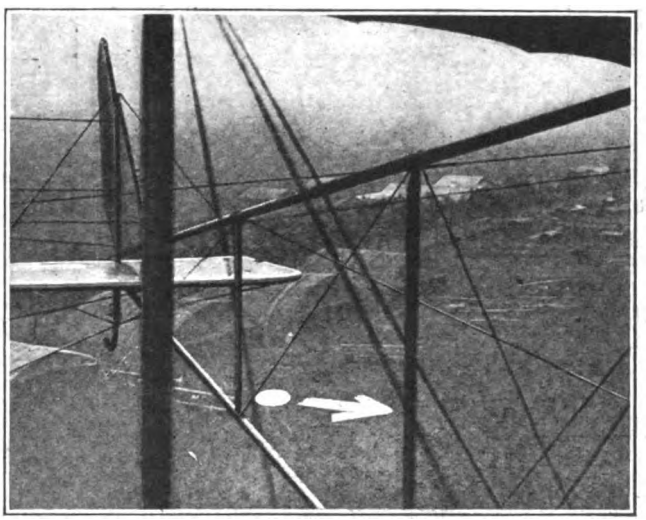
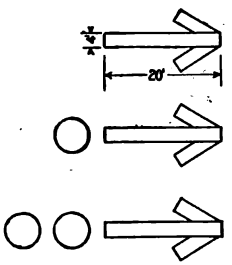
Arrow System Used by England in Guiding the Chariots of the Air

THE Germans are raiding England from the air so frequently and at so many different places that they often get by the coast patrol. Should a hostile airplane cross over his beat unknown to him, which often happens, as the distance to be patrolled is generally long, coast guards on the ground instantly notify him by means of a simple signaling system. He will see below him a white canvas arrow, twenty feet long, pointing in the direction taken by the enemy aircraft. If it is five minutes since it passed over, one circle is placed behind the arrow. After a further five minutes interval a second circle is added. Twelve minutes after the signal has been displayed it will be taken in, unless the enemy airplane is within range of a faster Allied airplane or is returning. As in the schoolboys' hare-and-hound paper chase, the British pilot has only to follow the arrows which are prominently displayed on the ground, until he sights the enemy.



The white canvas arrow in the picture points in the direction taken by an enemy airship. It is 20 feet long



One circle means five minutes have elapsed since he passed. Two circles mean ten minutes

At night, flares are arranged in the form of an arrow, the circles, however, being omitted. One objection to using this system at night is that often these flares are mistaken by the pilot for those displayed at a night-landing aerodrome. Searchlights are also a useful guide to the trail of the invader and are always turned in the direction in which the enemy airship was last seen.

How They Husband the Gasoline Supply in France

GASOLINE is extremely scarce in France, and its use for other purposes than those of war has almost ceased. The army is, of course, supplied with all the gasoline required for the military automobiles, airplanes, motorcycles, and motor-trucks in actual service, and a limited quantity is allowed to civilians who can prove that they need the gasoline for some legitimate purpose. To prevent the sale or the giving away of army gasoline to favored civilians the Government has resorted to the expedient of coloring all military gasoline red. A dyestuff is used which gives a distinct coloring without interfering with the quality of the gasoline. In one of the army services at the rear red gasoline was tested with the result that the average consumption dropped immediately. This proved that gasoline had formerly been sold or given away to civilians.

A Hailstorm of Bombs

A statement issued by the British War Office gives the following interesting data regarding the comparative number of bombs dropped by aviators on both sides during a single month. In the area occupied by British troops in France during that period German aviators dropped 1,482 bombs, while British airmen let loose 7,653 bombs over German-occupied areas in the same time.

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How Much Light Falls on Your Desk?

Lay this instrument on the table and measure illumination

TO measure anything you must have some standard of length, weight or capacity with which to make comparison; you must have what is called a unit of measurement. The bushel, the pint, the foot are such units of measurement. The unit by which the intensity of light is measured is called candle-power.

But light is one thing, illumination another. Light may be called the cause, illumination its effect or result. The unit of measuring the intensity of illumination of any surface is called a foot-candle. A foot-candle represents an intensity of illumination equal to that produced by one standard candle at a point upon a plane one foot distant from the candle and perpendicular to the light ray at that point. The foot-candle is a unit which applies to a point on a surface. By averaging the foot-candles at a number of points upon the same plane the average intensity of illumination of that plane may be ascertained.

It is often of great practical importance to determine how much illumination an electric light or other illuminating source will give at a certain point, be it a desk, a drafting table, a workbench or a sewing-machine, the position of which relating to the source of light can, for some reason, not be changed. An instrument, called a foot-candle meter, has recently been designed, which measures foot-candle intensities quickly and with a fair degree of accuracy. It is very simple in operation and so light that it can be easily carried about. The instrument is placed upon the surface the illumination of which is to be tested, the lamp is adjusted and even an inexperienced eye can read the foot-candle intensity from a scale.

A long and narrow opening in the instrument box is covered with a strip of opaque white paper or cardboard, upon which the graduated scale is printed. A number of small, round holes, corresponding with the graduations of the scale, are covered with transparent paper. Beneath one end of the perforated and graduated strip of paper, is a small incandescent lamp, which, placed at one end of the strip, illuminates one end of the strip with greater intensity than the other.

The device is placed so that the light falls upon the scale screen. The translucent spots of the strip at one end appear brighter than the white paper of the scale, while those at the other end seem darker. Find some dot that is neither lighter nor darker than the opaque paper of the scale. There the illumination by the lamp from underneath and the illumination from above are equally intense. The scale gives at a glance the foot-candle intensity corresponding to that dot.

He lays the instrument on the table and it tells at a glance how much light falls on his desk

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The game combines English cricket, American baseball, and a few other games

Cricket and Baseball Combined—A New Outdoor Ball Game for Boys

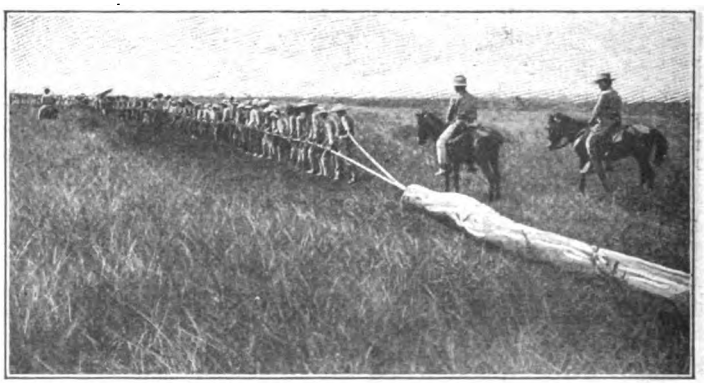
A NEW ball game has been invented, which is particularly designed for boys between the ages of eight and fourteen or thereabouts. The new game, which requires only a moderately large space, may be played by two or more boys, either for independent scores or as teams. It combines features of English cricket, American baseball and a few other games in a form suitable for athletic girls as well as boys. The equipment is simple and inexpensive; it consists of a bat, twenty-three inches long, with flat sides; a soft rubber ball, somewhat heavier than a tennis-ball; two wooden disks, five inches in diameter, to mark the bases; a net, two feet square, supported by stakes driven into the ground; and a rocker, which throws the ball into the air when one end is struck by the bat. No special clothes are required.

The rules are as simple as the equipment. The home base is put three bat lengths in front of the net, the field base twenty-five to thirty-five bat lengths from the home base. The batter throws the ball in the air by means of the rocker and bats it toward the field base. He is "out" if he misses the ball three times in succession.

After batting the ball, the batter runs to the field base and back to the home base. The fielders, whose place is beyond the field base, seek to put the batter out by catching the ball on the fly and throwing it into the net before the batter can return to the home base and bat some more.

Man-Power Is Cheap in the Philippine Islands

IN the Philippine Islands labor is still cheap and for that reason it is often employed in cases which, in the United States, would call for the use of labor-saving machinery. The accompanying picture illustrates the manner in which big logs are transported across the vast stretches of swampy ground which interfere with communication in many parts of the islands. Sometimes more than one hundred men are hitched to one of these big logs to drag them across the marshes. Enterprising Americans have tried to use automobile trucks but the roads were too swampy for them.



Labor like this is plentiful and cheap in the Philippines. What's the use, then, of machinery?

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Making It Easy to Remove the Large Globes of Street Lamps

BREAKAGE of the large outer globes of street lamps is reduced to a minimum by the use of a new clamp recently invented. The holding device consists of two sheet metal semi-circular forms connected at one side by a hinge and at the opposite side by a catch. The inner edge of this form is shaped to fit the flange of the globe, while the outside edge fits over the collar of the post. Three L-shaped slots on the outside edge of the form allow it to slip over the holding screens that project outward through the collar of the post.

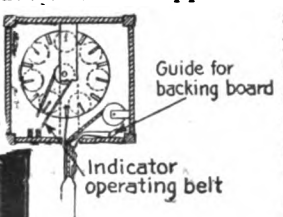
Showing how the clamp encircles the neck of the globe, and holds it fast

The form, clamped to the globe, is placed on the post, turned into position, and held securely in place by lugs!

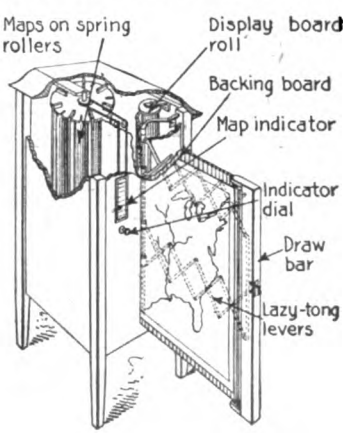
Select Your Map with a Dial and then Pull—That's All

A CABINET that can contain a number of maps on vertical rollers, and display them as wanted on an extension board which can be folded back within the cabinet when not in use, has been devised and patented by George S. Clason of Denver, Colorado. The illustration shows the cabinet with board extended to display a map. The maps are held in a cylindrical container, each map being mounted on a spring roller. On the outside of the cabinet is an index of the maps contained therein, and the operator has simply to turn a dial until an arrow registers opposite the number or name of the map wanted. The map is then pulled out on a draw bar by a system of rods and grippers which engage it. Thus extended, it is held rigidly on an extension board which is provided with a stopping device that holds it until released by the operator.

The extension board is composed of narrow strips hinged together, and the entire cabinet can be made of any material desired, whether wood or metal. This device should appeal to business men and engineers who must have at hand numerous maps and charts for reference.



The pictures show the general appearance of the map cabinet and details of its construction



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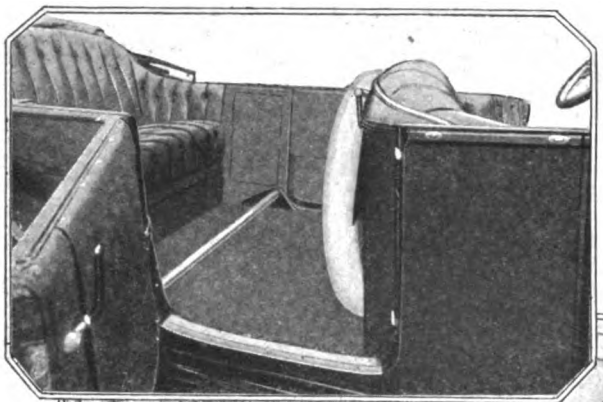
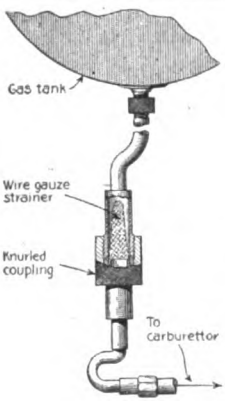
Live Topics of the Motor World

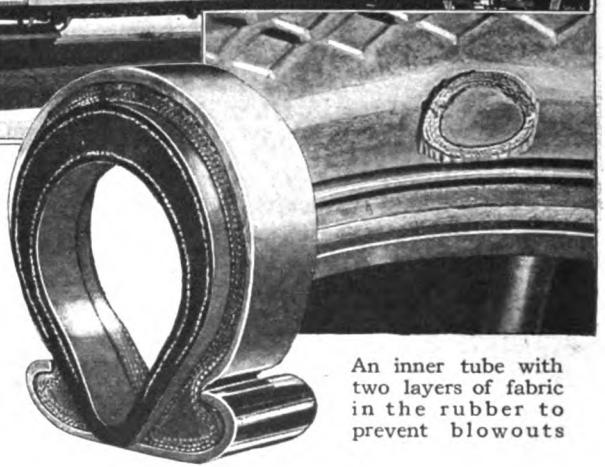


With this device a tire may be carried on the back of the front seat without discomfort to passengers

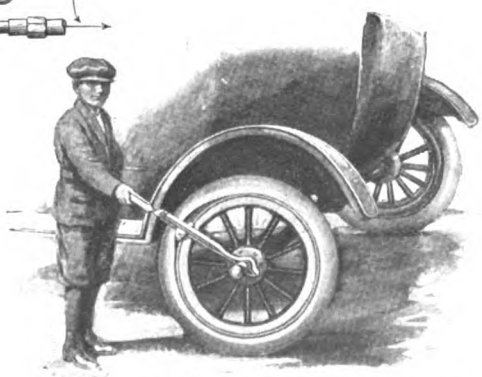
This van is twenty feet long, eight feet wide and eight feet high—largest ever built on a motor truck



At the left is shown a strainer placed in the pipe line between tank and carburetor on an automobile



An inner tube with two layers of fabric in the rubber to prevent blowouts



Lever attached to hub for revolving it as tire is removed from the bead on the rim

An adjustable valve grinder and manner of using it indicated

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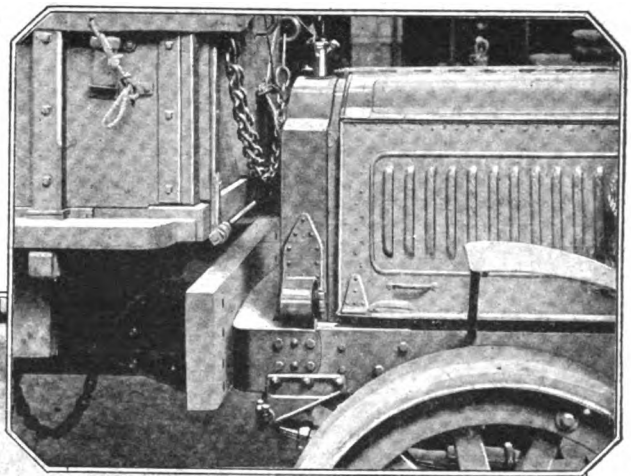
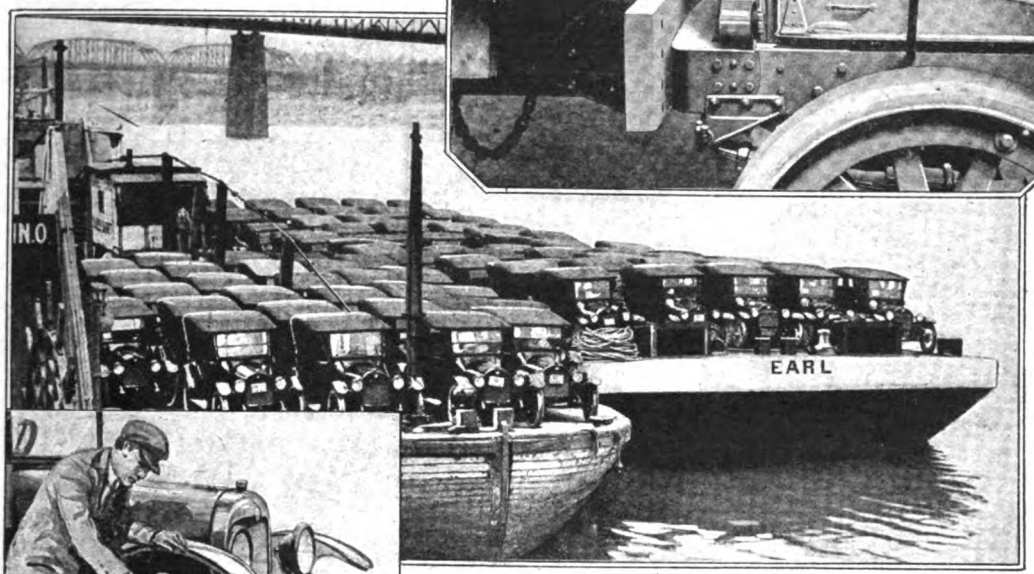
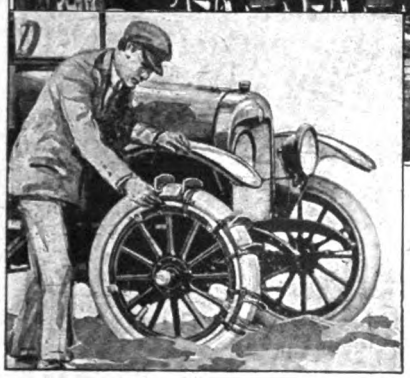
Live Topics of the Motor World

Both front and rear ends of heavy trucks are now provided with bumpers to save the radiators



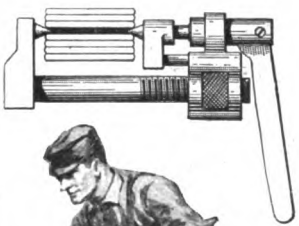


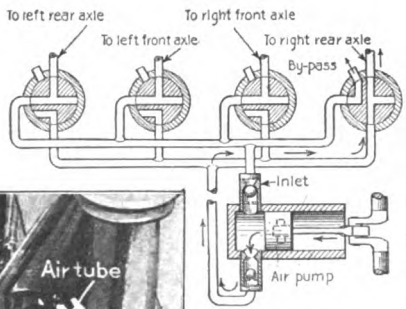
A shipment of over one hundred automobiles on barges from Cincinnati, Ohio, to Memphis, Tennessee



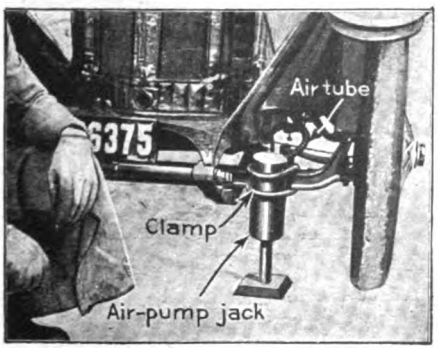
Double mud hooks for attaching to a mired tire. They can be applied at any place on the tire

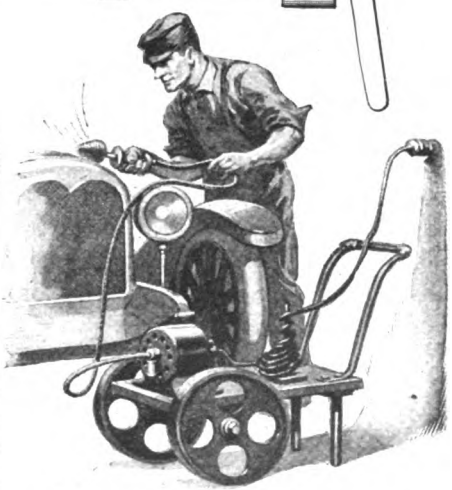
Adjustable spring leaf spreader is shown at the right. The leaves are spread by lever action





A set of four jacks is used under a car. They are operated by air and raise car from the ground





With a motor mounted on a low truck driving a flexible shaft and buffer auto parts can be cleaned

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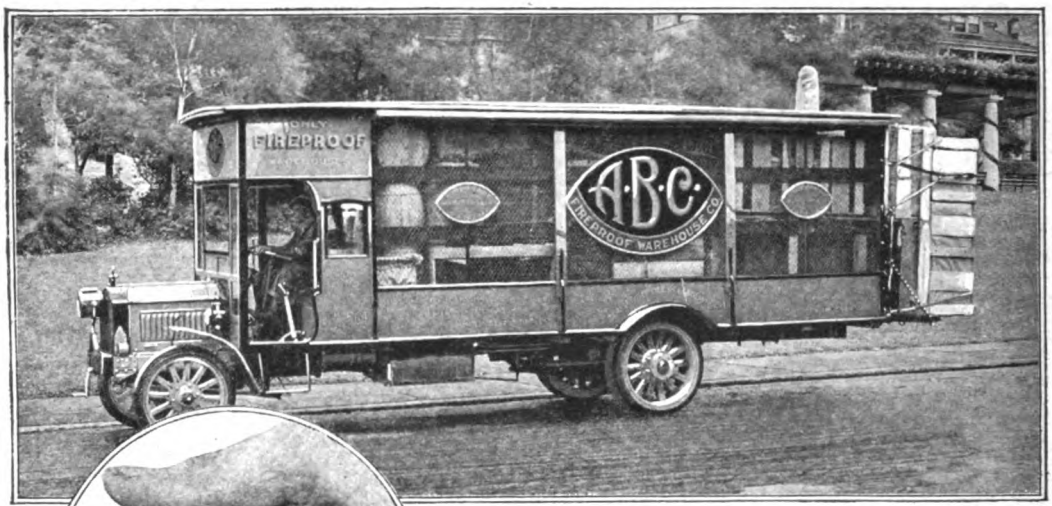
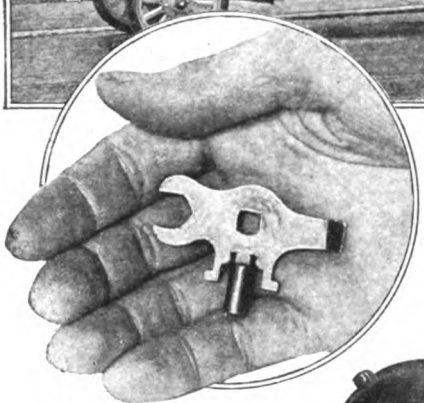
New Things in the World of Tractors,

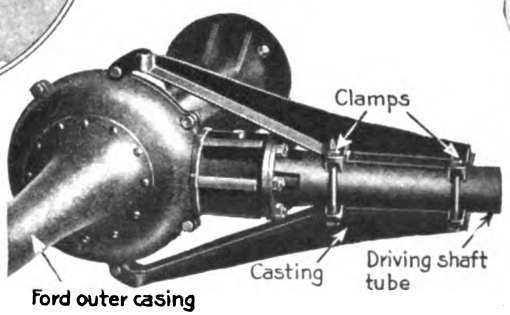


One of the largest motor truck bodies ever built, is twenty-two feet long with a three-foot tailgate. The full length of truck is exactly twenty-five feet

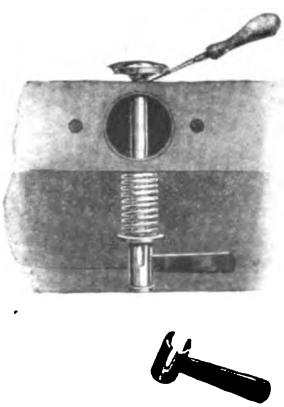


A four-fold purpose key for Ford cars. It can be used for a combination switch or gas tank key, vibrator wrenchandscrew-driver

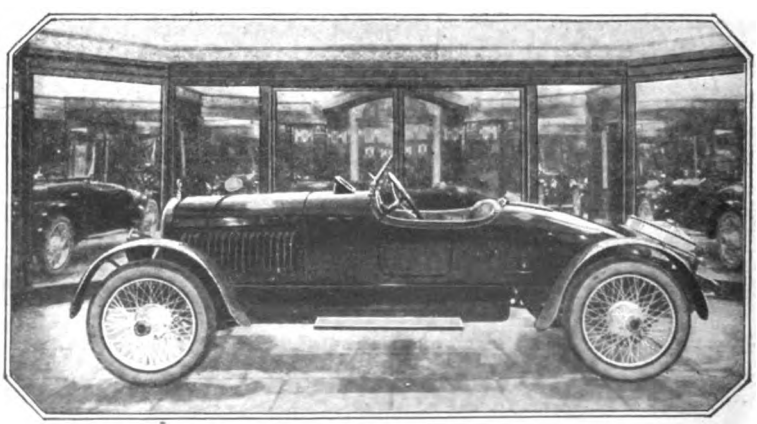
A groove cut in the sliding surface of a piston ring holds oil, making a perfect seal



With this brace attached to driving shaft tube of a Ford the shaft won't vibrate



Valve lifter as placed under a valve spring



How does your car look to the man on the sidewalk? Eight mirrors in this showroom reflect the image and tell you

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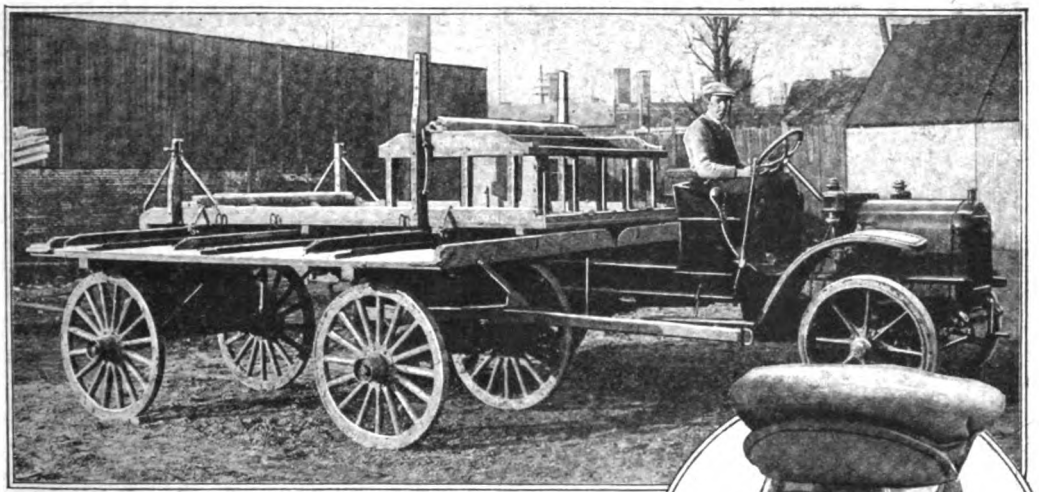
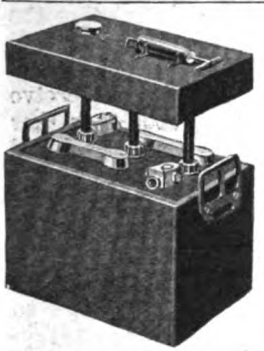


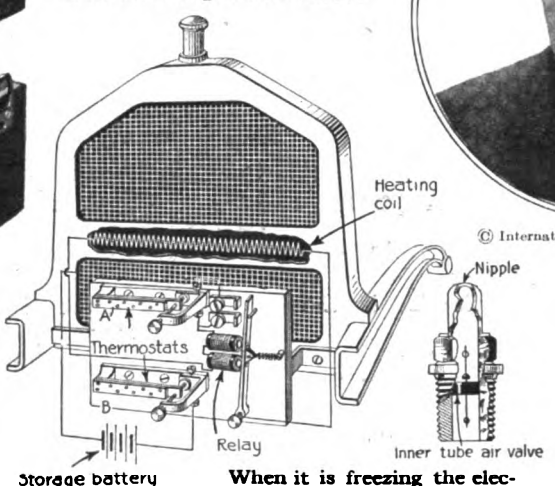
Transfer table for changing the entire body from a truck to a small horse wagon shown above



The removing or filling of the storage battery with water may be easily accomplished with this novel filler tank

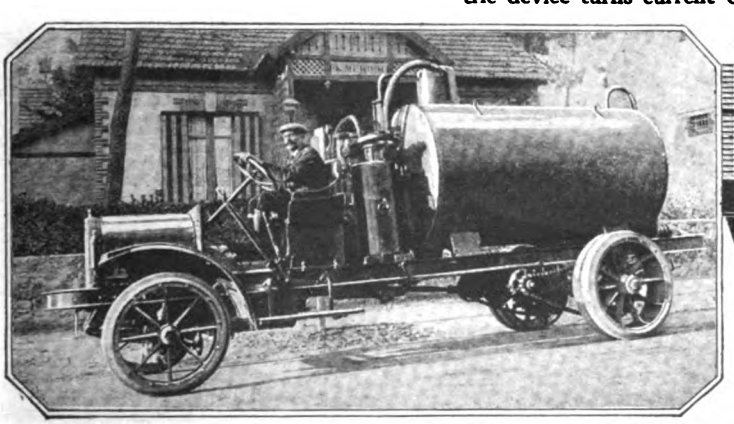
© International Film Service

A double piece visor for a cap. When the upper portion is raised the under keeps dust from the eyes

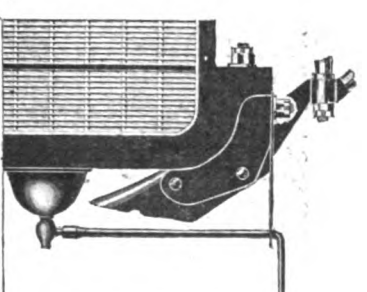


When it is freezing the electric device turns current on

A plug attachment that you can place in the spark plug opening for obtaining the pounds pressure with a tire gage



An army scavenger truck which is used to pump water and filth out of the trenches on the battle front



Radiator drain used in connection with a tile in the floor to let the water out in winter

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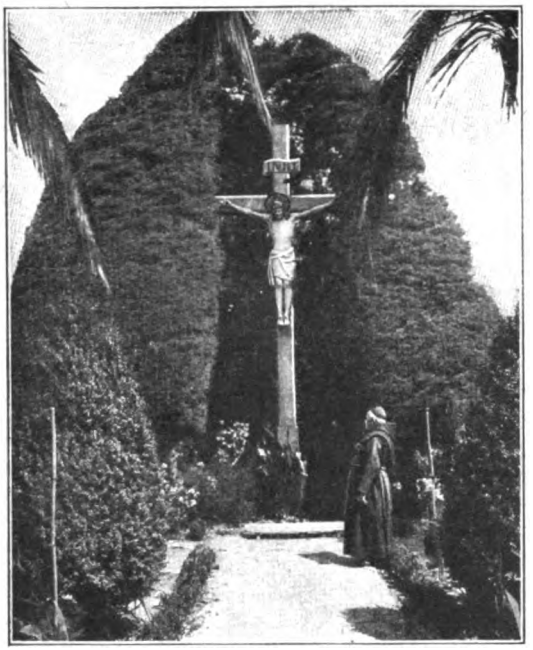

The Brother in the picture planted the group of cedars sheltering the crucifix 63 years ago

An Open-Air Shrine of Cedars—A California Priest's Conception

ONE of the numerous attractive features in the gardens of the Santa Barbara Mission in California, is the group of cedar trees forming the background for a tall crucifix, shown in the accompanying picture. The Brother in the picture planted the cedars sixty - three years ago and trained them to form an alcove around the crucifix. He has taken care of the trees and trimmed them from time to time during all these years and takes great pride in showing the sheltering group to the visitors of the Mission who flock thither from all quarters.

You May Injure Your Skin with Too Much Soap

DR. SAMUEL DIXON, Health Commissioner of Pennsylvania, asserts that the use of too much soap is injurious as it fills the pores with fatty substances which interfere with the activity of the glands of the skin. Very little soap is necessary to dissolve the dirt so that water can remove it.

Since soap has gone up in price there is still more reason for saving it.

A Game to Teach Children How to Read the Clock

MANY children find it difficult to become proficient in reading the clock. The subject is not in itself excitingly interesting, for which reason the instruction the children receive from their parents is usually rather perfunctory. The clock puzzle placed in the market by a novelty concern in Michigan offers an excellent method to make the study of the clock fascinating to children and at the same time instructive. As they play the children are familiarized with the clock and learn to tell the time of the day from the position of its hands.

The dial of the play clock is cut into irregularly shaped pieces after the manner of the picture puzzles. One side shows the dial with Roman figures, the other side with Arabic figures. After the dial has been assembled the movable hands are placed in position and the lesson in reading the time may begin. Just below each numeral is printed the time-equivalent in minutes, as for example, "Five minutes after," "Ten minutes after," etc. The value of time may also be inculcated with each lesson.

Teaching children mysteries of the clock by means of puzzle clock with movable hands

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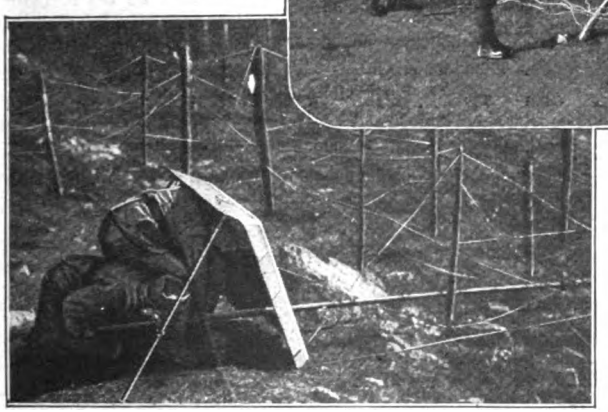
Getting Rid of the Barbed Wire Entanglement

BARBED wire entanglements were first used in warfare by the Boers in their brief struggle with Great Britain. It was recognized at once by all the military leaders of the world that a new and very formidable method of checking storming troops had been devised by South African farmers who knew nothing at all of military strategy. By the time the Russian-Japanese War broke out elaborate methods of installing barbed wire entanglements had been evolved.

It became apparent that wire-cutters would become an indispensable part of an infantryman's equipment. But it was also recognized that the cutting of barbed wire, in daylight at least, was almost suicidal. While artillery fire was the most effective method of destroying the entanglement, all the European armies have experimented with special entanglement destroyers. In England, France and Germany, these took the form of long poles at the end of which explosive charges were carried. England probably made the most extensive experiments of this kind, although the Russians proved themselves the more ingenious.

In one of the accompanying pictures an infantryman is shown advancing under the protection of a shield with one of these poles. If he gets to the entanglement alive (the steel of his shield is hardly thick enough to resist a machine-gun bullet) he will pull a kind of trigger or latch and explode the charge at the outer end of the pole in his hand. The destructive effect is far greater than would be possible if shears alone were used. As wires are often charged with electricity the long-pole wire-destroyer offers its operator some degree of safety.

Italian troopers erecting a barbed wire entanglement along the Piave. Wire stretchers are used very much like those with which our Western ranchmen are familiar



Infantrymen advancing under cover of a shield to destroy the enemy's barbed wire entanglements

Cherry Pits a Source of Valuable Oils

ABOUT 36,000 tons of cherries are grown annually in New York, Michigan, Wisconsin and California, of which eighty per cent. is canned. In order to can cherries the pits are removed, and in removing the pits juice is wasted. Some 1,600 tons of pits accumulate in a year, and 112,000 gallons of juice. Both are now wasted. But it will not be for long. A golden fatty oil, similar to the oil of sweet almonds, can be squeezed from the pits; it is worth $75,000. The cake left after squeezing can be treated to yield another oil, a volatile oil worth $10 a pound, and since 1,600 tons of pits would yield 6,000 pounds of this oil, the product is worth an additional $60,000. The residue after extraction of the volatile oil amounts to about 300 tons, worth $30 a ton as stock food. That makes $9,000 more. So the pits alone are worth a total of $144,000. Then, the juice would result in the production of about 5,000 gallons of alcohol, 21,000 gallons of soup or 85,680 gallons of jelly. The value of these it is difficult to appraise. At all events, the cherry industry must be wasting $200,000 a year. A chance for somebody to save this waste and make a fortune.

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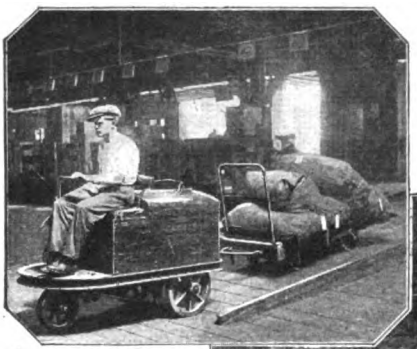
Electric Stevedores Relieve Congestion

How a simple invention is helping to increase our military and industrial manpower



The small tractor run by one man pulls the loaded trailers from the platform to the cars

General view of Pier 4, Pennsylvania R. R., Hudson River, New York City

The empty trailers are collected and taken back to the platforms to be reloaded for another run

SMALL electric industrial tractors would solve the problem of freight congestion of New York city's piers and incidentally release from five thousand to seven thousand men for other vital war work, even if only approximately fifty thousand tons of freight were handled daily. How do we know? Simply, by the wonderful results accomplished by only four such vehicles at one of the Hudson River piers. Before these mechanical means were substituted for human muscle in moving freight, the pier was clogged with goods. Now it is the least congested. Before, it required the services of one hundred and sixty-five men to move twenty-five carloads of freight, or two hundred and seventy-five tons. Now it requires only one hundred men to move forty carloads or four hundred and forty tons daily.

These wonderful results at a small expenditure of capital have meant advantages to the railroad, to the transfermen taking the freight to and from the piers, to the shippers and receivers of the goods and possibly to many inhabitants of the city, since the goods handled are consumed either as material to be manufactured, or food to be eaten. The railroad has been able to do more work with fewer men and at a lesser cost than formerly. The transferman gets his goods more quickly and is able to deliver them in a shorter period of time. This means an opportunity for increased work and greater profits.

While the success of the installation has been due primarily to the introduction of mechanical means, it depended to a great extent upon the manner in which they are used. The four industrial tractors are used in connection with two hundred and twenty-five four-wheeled hand-trucks. These trailers are disposed around the edge of the pier headhouse

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which is made up in the form of a huge U. The inner area is a few feet lower than the platform extending clear around the base and arms of the U. No wagons or trucks are allowed on the pier. They must back up to the platform as shown in the accompanying plan view. The freight going out is handled on one pier and the incoming goods on the other, to avoid confusion. The U-shape of the platform gives double the unloading space of the ordinary straight-sided type. The trailers are pushed against the inside edge of the platform with which their body floors are level to prevent lifting, or they are run upon the platform on short ramps when the load of a wagon will fill one or more trailers. After being loaded to full capacity, the trailers are coupled together to form trains of five or six. This is done in the center of the floor in much the same manner as freight trains are made up in a switching yard. A tractor then pulls the train directly to the car float. As the train passes the doors of the freight cars, the trailers are uncoupled and their contents loaded into the cars by men who do nothing else. On the return trip, the tractor collects the empty trailers and hauls them back to the edge of the platform where they are again loaded in the same manner as before. Platform scales are placed along the edge of the platform to weigh each trailer load before it is taken down into the yard.

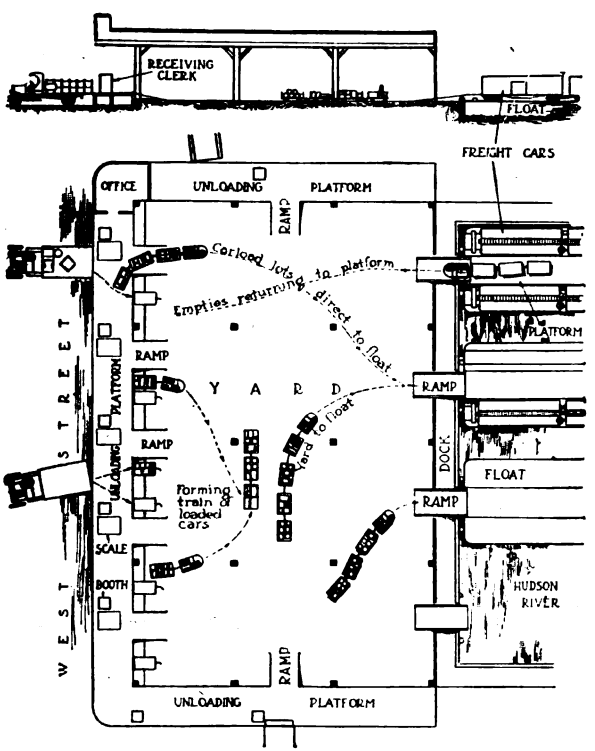

Diagram showing the arrangement for freight handling at Pier 4 of the Pennsylvania Railroad

The Terrific Strain of Trench Warfare at the Front

AFTER serving with the American Ambulance at the front, Dr. George W. Crile writes of trench warfare. "The nearer the trenches," says he, "the more desperate and intense is the fighting. ("A Mechanistic View of War and Peace," The Macmillan Company.)

"In trench fighting, both sides have adopted every variety of flame, acid, and explosive that ingenuity can devise. Every ruse, every stratagem, is employed in the close personal contact. It is as if one were contending all day and all night with a murderer in one's own house.

"In the first impact of war, many men in all of the armies became insane; many underwent nervous breakdown; some became hysterical; but the great majority became seasoned and maintained a state of good health. The rigid, alert, muscular response uses up much energy; the appetite is active, digestion good, and if the supply of food is adequate, the balance of nutrition is maintained. I have observed, however, that soldiers in the trenches show unusual lines of strain upon their faces, giving them the appearance of being from five to ten years older than their actual ages.

"While the proximity of the trenches has brought intensive fighting, it has also brought its counterpart,—fraternizing between the opposing sides. The men hear each other talk and sing, one side signals, the other answers, and their representatives appear and exchange food, tobacco, and newspapers."

In general, we may say that the warfare of the trenches represents an intense, though not necessarily a destructive activation of the system, which might be compared with the activation of prolonged athletic contests, or prolonged intense mental application, such as a chess contest, or the taking of difficult examinations. However, the first line fighters must be regularly and frequently relieved.

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Doing the Albatross Amble

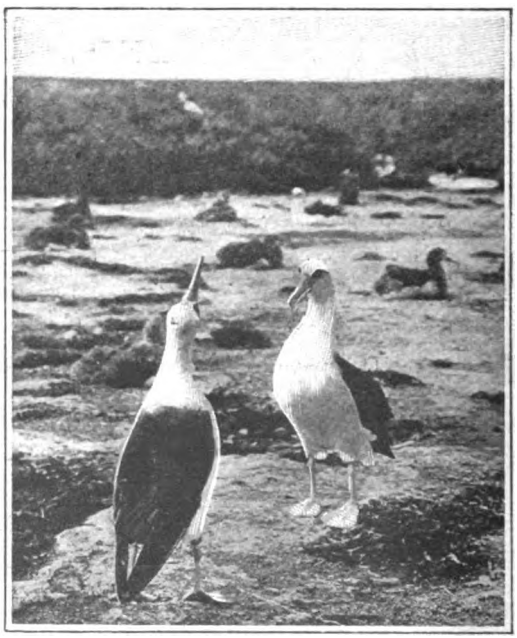
A new dance from the Hawaiian Islands that is unaccompanied by the ukulele

The albatrosses of the Island of Laysan, part of the "Paradise of the Pacific," may not be tame, but they refuse to be intimidated by trousers and hats

IN the middle of the Pacific Ocean about eight hundred miles west of San Francisco and a little north of Honolulu is a solitary isle about two square miles in area called Laysan. It is of coral origin. Its only inhabitants are millions upon millions of birds. More unusual still, however, is the fact that the most numerous of them, the albatrosses, have even developed little social customs of their own.

An albatross is a good deal like a farmyard duck, only bigger. Now a duck has no grace of form, being built a good deal like an underslung automobile—that is, set kind of low on the hind wheels. The bird is not cut out for sylph-like waltzing or other "light fantastic toe" stunts. But these Laysan albatrosses, duck-like waddlers though they are, manage to be real social lights.

The albatross in making formal calls approaches his neighbor, who sallies forth to meet him. The visitor struts forward with wings outspread in greeting. There is an exchange of courtesies. The host reaches around under his wing perhaps, as if to draw a cigar from his vest pocket and to proffer it to the visitor, much as a human being might do under similar circumstances. Visitor and host ceremoniously nod their heads and dip their stubbed tails in dignified unison. The visitor does a cakewalk around his host, spreading his massive wings and lifting his flat feet with all the fervor of an end man at a minstrel show. The host catches the enthusiasm and emits a series of spontaneous honks heavenward so that all the neighborhood may know the joy that reigns in his midst. After



One bird is pouring his soul out in a solo—the other snaps its bill in vigorous response

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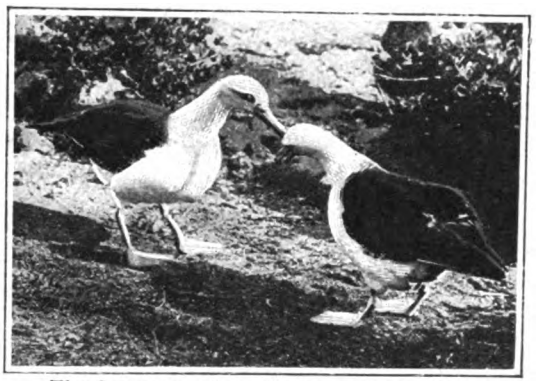
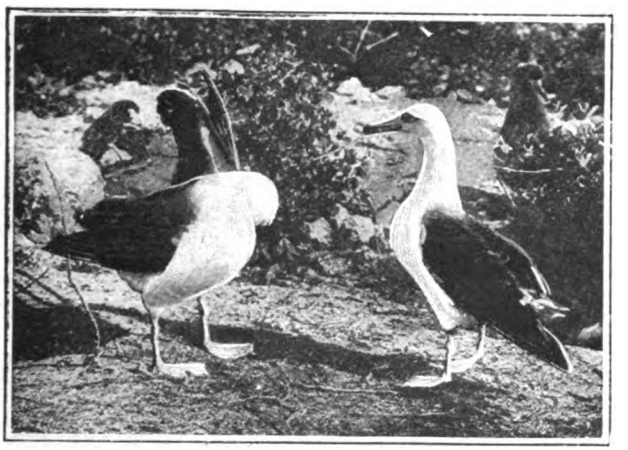
more cakewalking, in which both birds join, the reception winds up in a grand finale composed of more honk, more flapping of wings, and more strutting until the participants decide that the occasion has been properly polished off in a befitting manner. The visitor then ambles off, only to repeat the performance with the next feathered neighbor on his calling list. Why the birds go through this ceremony—thousands of them in different parts of the island at the same time and all the time—may only be conjectured. But birds living by themselves in this manner through countless centuries may easily develop strange customs all their own.

These birds are rendering a duet, uttering curious wails as our stars do in tragic, heart-rending opera

There are more than two thousand varieties of birds found on Laysan beside the albatross. One can hardly take a step without stepping on their eggs. The birds, not having been disturbed by man or other animals, know no fear and will come up to visitors in a nonchalant way.



The first stage of an albatross dance. The dancers have bowed and now rub their bills



The second step in the dance, wherein one bird bows, points its beak upward, puffs its breast and says, "Ah"

Does War Breed a Sense of Fear in Animals?

An English writer has made some interesting studies of the behavior of certain animals under war conditions. From him we learn that parrots were employed as sentinels at the Eiffel Tower in Paris, and could be relied upon to give warning of an approaching aircraft at least twenty minutes before it could be seen by the naked eye. These birds, however, grew "bored" after a while, and ceased to be dependable. Pheasants, too, were wont to give warning at night when an airplane approached, screaming and chattering noisily. It is also stated that hares, partridges and pheasants were often observed near the front-line trenches in search of food—which they got if the rats didn't see it first. It would seem that war has had no effect on them.

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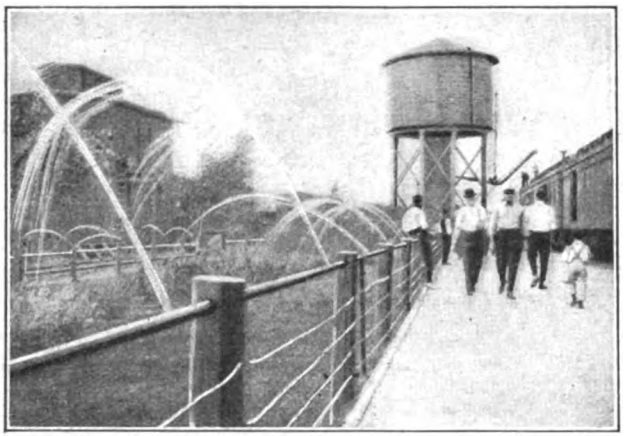


The top railing of the fence is ordinary piping with holes punched at intervals. The tank furnishes the water

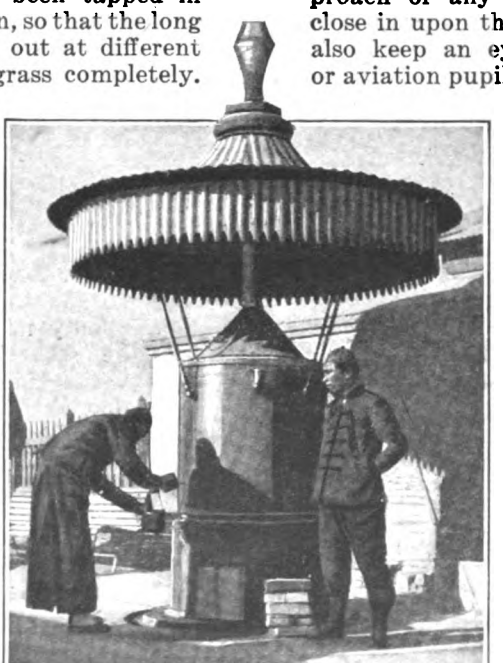
Using a Fence to Water the Lawn at a Railway Station

THE railroad officials at Mobridge, S. D., have installed a unique system for watering the station lawn. Since the fence railing is simply a pipe, it was decided to utilize it to carry the water. Holes were drilled at convenient intervals so that the water could spurt out. The holes have not been tapped in just the same position, so that the long line of sprays shoot out at different angles to cover the grass completely.

Making Tea at a Railway Station

IF you carry a teapot with you when you go on a railroad trip, you may experience some trouble in getting hot water when you want it—that is, if you travel in the United States. If you happen to be on the Mukden-Tientsin Railroad in China, however, you can get your boiling water at every stopping-place. Every station boasts one of the boilers shown in the accompanying illustration, and an attendant keeps the water boiling, so that the passenger, supplied with his own (or her own) teapot and oolong, can get off and fill up the pot and have a nice cup of fresh tea with the lunch or cakes that ought to go with it. The water tank is heated from below and is sheltered by an umbrella-shaped awning made of corrugated sheet iron.

It may be of interest to mention that the Chinese and their teapots are almost inseparable. They will not travel far without them.



Waiting for the 2.45 on a railway station in China means a cup of tea. Will the New York Central please copy?

Look Behind You While You Fly In an Airplane

THE old adage, "Look before you leap," may well be amended nowadays to read "Look behind you while you fly." In Europe the aviators are now as a rule equipped with "back-sight" mirrors on their airplanes, so that they can observe not only the approach of any machines that may close in upon them from behind, but also keep an eye on the passenger or aviation pupil seated behind them. It is frequently only a narrow margin that saves an aviator from a collision with an airplane approaching from the rear when making an abrupt turn, and on several occasions it may be desirable for him to observe what his companion is doing in the rear of the cockpit. Such a mirror serves both purposes.

If all aircraft from the beginning had been equipped with these "back-sight" mirrors any number of fatal accidents that have occurred might have been prevented.

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An "at home" in the Arizona desert, enforced by the breaking down of one of the two Fords in which the party traveled. To camp out in the broiling sun is not all fun

Crossing the Arizona Desert in a Ford

THERE was a time when the crossing of the Arizona desert was an undertaking attended with tremendous risks. Many a prospector or ranchman who started on the hazardous journey, relying upon his trusty pony, was never heard from again. His bones are probably somewhere in that vast expanse, bleached by the merciless sun. Nowadays the desert is crossed frequently, and the best route is marked by a fairly well defined trail showing many wheel tracks, among them the tracks of light types of automobiles, principally Fords.

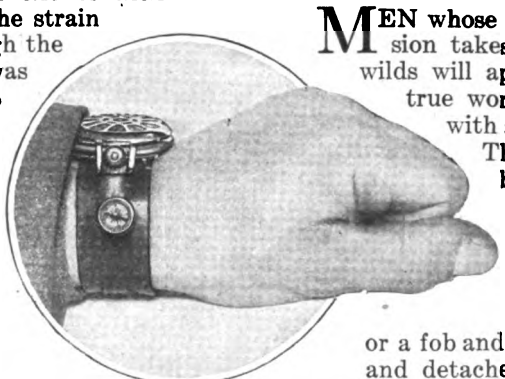
The illustration shows a party which came to a halt in the middle of the desert, because the rear wheel of one of their Fords broke down under the strain of plowing its way through the sand and gravel. There was nothing left except to make the other Ford light and to send it back to civilization for a new wheel. In the meantime the members of the party are camping out in the desert, an occupation which by no means could be construed into the proverbial picnic, for camping under a broiling sun is far from agreeable.

Acidity in Oil Lubricants Causes Wear of Metal

THE metal layers of an engine that come in contact with one another rub off small particles of matter that combine with the lubricant used and form a dirty and sticky mess. The olein contained in the lubricant will in course of time form an acid, known as oleic acid, which has a deleterious effect on the metal parts that it touches, causing progressive corrosion. But luckily, it is only when its oleic-acid content exceeds one-quarter of one per cent that an oil becomes unfit for lubricating purposes.

A Compass That Guides by Night as Well as by Day

MEN whose calling or diversion takes them into the wilds will appreciate at its true worth the compass with a luminous face. The compass can be secured to the wrist-watch strap of a soldier or hunter, an automobilist's gauntlet or a fob and can be attached and detached without difficulty. The luminous face makes it useful at night.



The luminous compass attached to a wrist-watch strap

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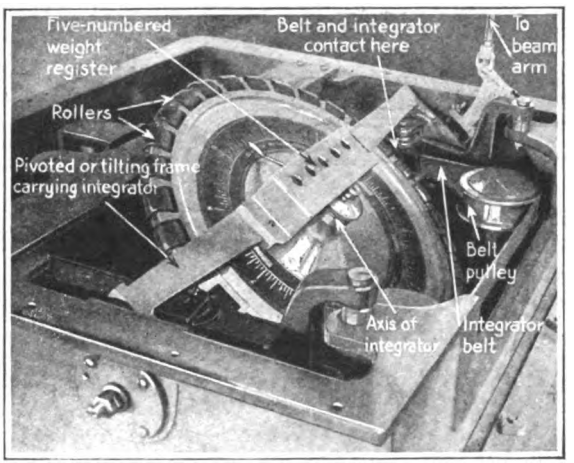
Weighing Loads on the Run

In an endless stream, coke, coal, and cement pass on; yet every pound is weighed without a stop of the conveyor

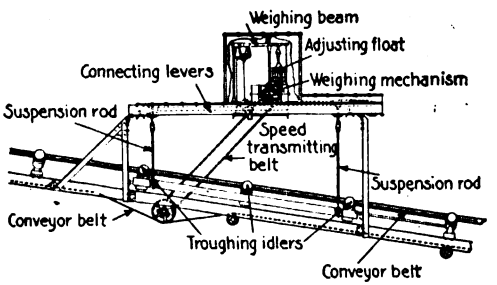
AN automatic weighing device recently introduced by an Eastern manufacturer of scales solves in a clever and decidedly interesting manner the problem of weighing material like coal, coke, cement, crushed stone, etc., while it is carried on a belt conveyor and of making a record of the weight of the passing load, without stopping its flow.

Several of the troughing idlers which support the conveyor belt are placed upon suspension angles which hang from suspension rods. These rods, by knife-edged pivots, are connected with a system of levers, which, in turn are connected with the weighing beam. This beam is automatically brought to poise for different loads on the conveyor by a steel cylinder hanging from the beam and floating in mercury. As the loads vary the cylinder floats at different levels on the mercury, permitting the beam to tilt in proportion to the weight.



Every pound passing over the conveyor leaves its record in the tell-tale disk in automatic manner

A slender rod attached to the end of the weighing beam above connects it with the weight indicating mechanism. A frame supports this mechanism, a frame which is so pivoted that the changes in the position of the weighing beam are communicated to it by the connecting rod just mentioned, so as to tilt it a degree which depends on the deflections of the weighing beam.



There is no guesswork about this mechanism; it's very similar to a cash register

Mounted across the bars of the tiltable frame is the shaft of the weight-indicating disk. While free to revolve between the bars, the disk is forced to tilt with the frame to which it is attached. In accordance with the weight on the conveyor this disk is tilted from the vertical to a varying degree.

Into the edge of the disk, all around the periphery, small rollers are set, which come in contact with a narrow endless belt at two diametrically opposite points of the disk's periphery. This belt is driven in a horizontal circuit by a pulley deriving its power from the conveyor belt. When no load is on the conveyor and the disk correspondingly stands vertically, the narrow belt runs at right angles to the plane of the disk. As soon as the disk is tilted by the conveyor load, its position relatively to the driving belt, with which it is in contact, will change. Even a slight tilt will cause the belt to give to the disk a slow rotary motion, and the greater the tilt, the nearer the plane of the disk coincides with the plane of the belt circuit, the greater will be the speed of the disk. A five-figure counter operated by the end of

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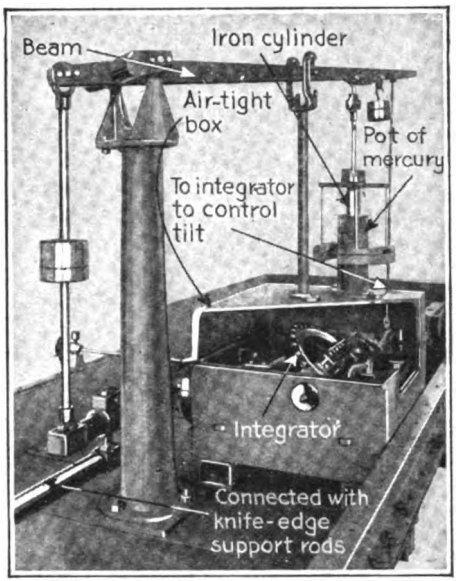
the disk-shaft records the rotations of the disk. By correctly choosing the speed reduction between the conveyor and the narrow driving belt of the weighing mechanism, the counter will indicate weight in pounds, tons, kilos, or any other units.

This device, once installed and properly adjusted, does its work faithfully and correctly and requires but little attention. It means a large saving of time, labor and expense in all factories where bulk material which enters into the process of manufacture must be weighed while it is conveyed on a belt.



This shows in detail the weighing mechanism and its connection with the integrator which indicates the weight

Armor for the Shock Troops of the Modern Army

THE German army has provided armor for snipers, sentries and observers, the suit being designed chiefly for soldiers whose duties are stationary. The metal helmet is common to both the Allied and German armies.

A cuirass invented by Oscar Schaumann, a German, in 1908, attracted considerable attention. It has three plates, the first being of extremely hard steel and designed to break the points of the projectiles striking it. The second plate is composed of aluminum or duraluminum and the third of celluloid or horn. A softer substance, such as silk or asbestos, may be interposed between the plates and the cuirass proper to lessen the force of the bullets. The first plate, however, is designed to take away the momentum of the projectiles so that when they strike the cuirass proper it will be only slightly dented. Tests of the cuirass proved satisfactory.

A portable buckler fashioned after the ideas embodied in this cuirass is described as being studied by the Prussian Department of Artillery Technology. A plate of hard steel riveted to a plate of duraluminum constitutes the principal feature of the shield. Two leather bracelets fastened to the left forearm enable the infantryman to carry the shield. It does not interfere with the movements of the soldier and has considerable protective value. Reports of battles in Europe have not revealed the use of this buckler, however, this being due to the fact that all the available supply of duraluminum in Germany was needed for the building of Zeppelins. It has been pointed out that the buckler could be employed to great advantage in throwing bombs because it enables the soldier to have the free use of his hands.

The steel helmet worn by the soldiers in the European war has demonstrated its protective value unmistakably. Records of battles since September, 1915, show that it saved the lives of many men.

The helmet does not always stop bullets, but even when it is pierced it weakens the projectile's force so as to prevent serious injury.

He goes clanking like a junk wagon across No Man's Land

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Developing a Fast Swimming Stroke

An engineer's swimming suggestions for increasing efficiency

By Marius Krarup, C. E.

THERE is room for engineering in the sports to revise faulty traditions and to hold the interest of those who demand more than physical exercise.

Most swimmers operate as a single-cylinder engine without a flywheel and therefore move in jerks. Yet they are equipped with four independent power elements—their hands and feet—and could, by practising, time their power strokes on the plan of a four-cylinder engine. Horses and dogs do so naturally but have not learned to make the idle strokes slow enough. The idle strokes have the body speed in addition to their own against them, and all expedients are valuable which (without too great special exertion) reduce the surface and the speed with which these idle strokes act against the water. The thighs, arms and shoulders are the chief sinners in creating resistance.

A complete cycle of movements comprises at least four power strokes and four idle strokes. The first one-fourth of the cycle may be the full-power stroke of the left arm plus one-third of the idle strokes of the three other limbs; the second fourth may be the power stroke of the right arm plus one-third of the idle strokes of the other limbs; and so on as indicated in diagram Fig. 1. Some of the leg strokes may be subdivided into quick jabs without interfering with this general plan for obtaining continuity of power application. If the duration of the cycle is two seconds, there is only one half a second each of the four power - strokes and 1½ seconds for each of the idle movements. By combining this timing schedule and by devising movements by which the idle strokes are made as harmless as possible—so that little is lost by making them too fast—it should be quite feasible to double the average degree of efficiency of the best swimmers.

Claire Gallegan of New York and Dorothy Burns of Los Angeles in a close race

The overhead, crawl, trudgeon and scissors strokes derive their superiority largely from complying with these requirements in some degree, but can probably be greatly improved when many swimmers begin to keep their minds on the right principle and strive to modify their movements accordingly.

The development of a stroke for fast swimming under water, where overhead action is inapplicable, should be interesting. The subject has several other complicated minor factors to be considered. The absence of a keel, or a dorsal fin, on the human body; the possible hydroplane action of the breast; the relative powers of the four limbs; the higher or lower "gearing" of the hand stroke according to

Every slight movement counts for or against your speed in swimming

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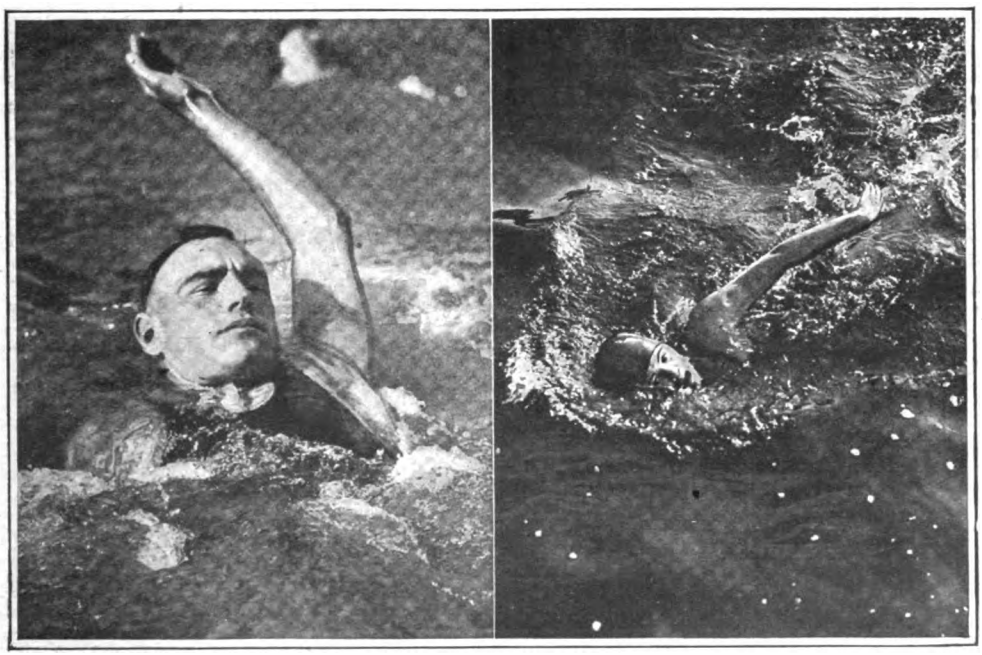
whether the arm is stretched or crooked. These must not be neglected. But they have an unmistakable way of asserting themselves, and can be passed by with bare mention here. The continuity of the propulsive movements, on the other hand, must be developed by deliberate self-training (some of which can be done on a mattress) and is of equal importance for a spurt stroke, a distance stroke and an under-water stroke. These three and at least one stroke for swimming on the back are waiting to be standardized.

The need of continuity is based on the fact that in water the resistance increases as the square of the speed. Steamers consume four times as much coal at doubled speed. Assume that one swimmer makes 90 yards in 60 seconds at an even speed, steadily overcoming a resistance which, for convenience in expression, may be designated as 10 pounds per second. The total exertion is then equal to 600 pounds. Another swimmer doubles the speed for 15 seconds, making half the distance against a resistance of 40 pounds per second. The total exertion is 600 pounds, or as much as the first man's for the whole distance. Whatever exertion he must make to cover the last 45 yards in 45 seconds, equalling the total time of the first man, represents his loss of efficiency. One yard per second is two-thirds of the first man's speed. The resistance to it is therefore $\frac{2}{3}$ squared multiplied by 10, or $4\frac{4}{9}$ pounds per second. For 45 seconds this makes just 200 pounds. His effort is increased 33 per cent through lack of continuity in the application of power. The result is the same whether he doubles the speed continuously for one-fourth of the time and then drops to two-third speed, from fatigue, or moves in jerks each of which has a speedy first half and a slow second half. The latter only is the commoner way of committing the error.

A Well That Is More Than a Mile Deep

A WELL being drilled on a farm in West Virginia in search of deeper oil sands penetrates into the bowels of the earth for 7,363 feet, or nearly one and one-third miles. It is hoped to find gas or oil under great pressure at a still lower level.

The depth of this well exceeds the height of Mt. Washington.



Here is Richard G. Dungan practising his backstroke preparatory to entering a race

Miss Marion Gibson just at the finish of a vigorous and hotly contested race

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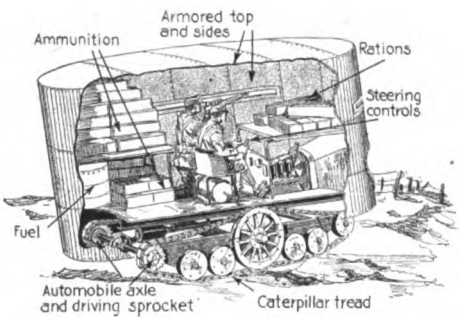
Ford's Artificial Armored Horse

The new two-man tank designed to take the place of cavalry

CAVALRY is almost as extinct as the Dodo or the Mammoth. The machine gun, barbed wire, shells that bury themselves twenty feet in the ground and then explode are responsible for the passing of the trooper. Horses cannot be used to advantage in shell-pitted territory and against a hail of machine gun bullets. No adequate method has been devised up to the present time to protect the horses against rifle and machine gun bullets, shell splinters and shrapnel. And so military men have had to invent an artificial armor-protected horse—the two-man tank, which is light, mobile, fast as a horse, and which wriggles in and out of shell craters with astonishing ease.



Ford's armor-protected tank has the caterpillar treads along the bottom only

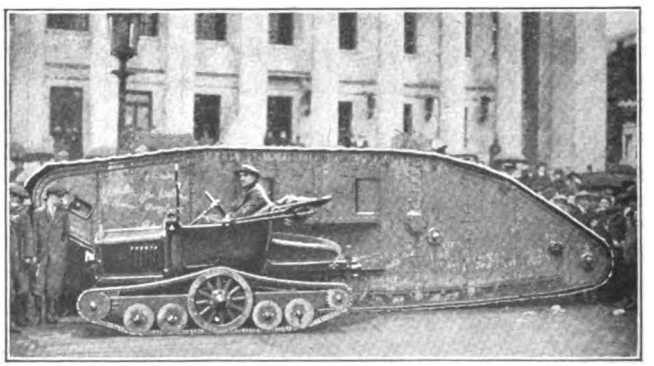
The two-man tank has been linked up with the name of Ford because it is proposed to use Ford engines to supply its power. It is the invention of C. H. Martin of Springfield, Mass., who has already constructed three of the units with the exception of the armor.

The first of the two-man tanks to be seen in public was shown recently in Springfield, Mass. In the accompanying picture it stands by the side of one of the British tanks. It is about one-half the length of the big tank and consists of a Ford power-plant mounted on a sub-frame. The driving sprocket is at the rear end, and on each side there is a big tread wheel in the center, with two smaller idlers in front and two in the rear.

The armor of this small tank weighs about 1200 pounds. At the present time no definite description can be given of the armor, but it is stated that each tank will carry two machine guns and will be able to travel at a speed of twelve miles an hour over fairly smooth ground and with half that speed over shell-scarred terrain.

It is claimed in favor of the small tanks that, because of their lesser weight they can go to places which the big tanks could not reach. It is also argued that a larger number of small tanks can do more damage than a smaller number of large tanks and at smaller expense. The armor of these two-man tanks is intended to deflect machine-gun-fire. Their speed will make it possible to use them in place of cavalry for quick dashes into the enemy's country.

It has been rumored that these tanks will be more like giant wheels than the familiar elongated British tanks. Hence they may resemble the tank shown in the accompanying sketch, in which the caterpillar treads are run completely around the circumference of



The Ford mounted on a special chassis with caterpillar tread is standing by the side of a British tank which it surpasses in speed and mobility

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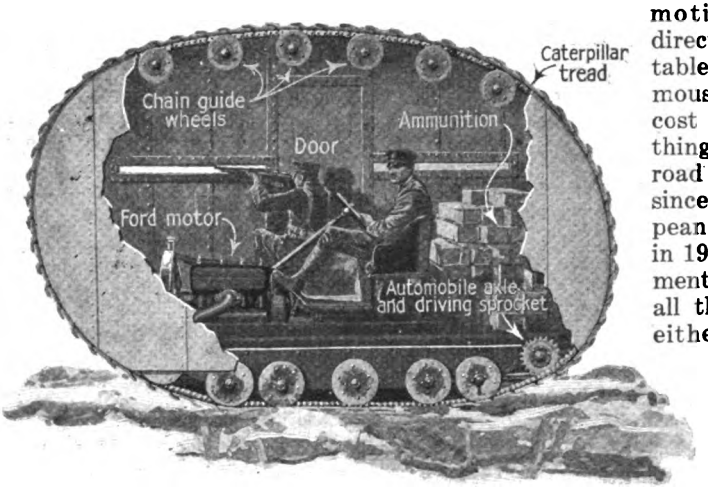
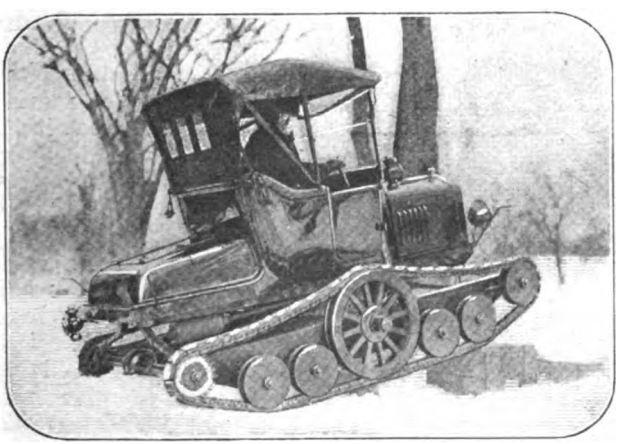
the wheel, the inner portion of the wheel being armored and remaining stationary.

Another possibility is that the new tanks will be patterned after the latest French tanks in which the caterpillar treads extend along the bottom only and are partly protected by the side armor. In that case the front and rear ends will be beveled to give the machine gunner and the operator a clear view for sighting their guns. In either case the tank will be steered by a modified Ford control to permit of stopping and starting either tread at will. If the French type of armoring is used, the tread could be arranged as shown in one of the pictures.



The Ford tank is more like a giant wheel with caterpillar treads around its entire circumference

The tank as a war machine is, like so many other new inventions, still in an experimental state. But it has proved itself so useful already that it will undoubtedly be made a part of the equipment of every army, although its structure may vary.



The creeper tread of the Ford easily surmounts obstructions that lie in its path

Cost of Railroad Equipment Has Gone Up the Last Four Years

THE transportation troubles of last winter—especially those which were due to shortage of freight cars and locomotives—were directly attributable to the enormous increase in cost of everything that a railroad needs, ever since the European War started in 1914. Equipment buyers of all the railroads either had to buy rolling stock and rails and repairs parts at from 50 per cent to 150 per cent increase over former rates or wait till prices dropped with the return of peace. For the most part, they preferred to maintain a "watchful waiting" policy; hence, the inevitable detriment to the service.

A good idea of the huge rise in prices of all railroad equipment may be derived from the following facts:

A serviceable box car that formerly sold for $1,200 cannot now be bought for less than $2,600, and locomotives have gone up from $30,000 to $60,000 apiece. Steel rails which in 1914 could be obtained for $31 per ton are now shipped at $46. The cost of passenger cars has risen in the same proportion.

It is little wonder that railroad managers bought sparingly during the last four years, even though their purchases are made on the installment plan. Uncertain about the future, they were afraid to mortgage the income of their properties. They put off the placing of their orders, hoping against hope that the war would end.

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We never thought there was much music in a boiler-factory, but we're not so sure since the riveting machine is now part of Sousa's band

Stop Your Ears! The Band Is Playing the Boiler Makers' Fox-Trot

AN electric hammer that will imitate the sounds made in riveting during the construction of ships and boilers has been devised by Louis Paulero, of Petersburg, Va., for the use of bands in rendering a musical march composed especially for the ship-builders of the United States. The invention was designed particularly for reproducing the sounds made in a ship-building plant, but it can also be employed to imitate the reports of a machine gun. The hammer was provided for the United States Marine Band in response to a request from the United States Shipping Board.

The instrument is mounted on a square steel plate, supported on springs over a wooden base. The drummer can operate the hammer by pressing a button either with one of his hands or feet in order to turn on an alternating current. The adjustment of a switch enables the device to be tuned so as to produce a tone that is high and shrill or one that is low and dull.

The new instrument was an ear-splitting success in Sousa's march, the "Volunteers," when it was first played in a concert given for the employees of the Shipping Board and the Emergency Fleet Corporation. The picture to the left shows that the electric hammer was played by the drummer of the band.

Making It Easy to Handle Large Blueprints

FILES or holders hitherto devised for blueprints are unsatisfactory. Their locking device is too insecure or too complicated to permit the quick handling of the prints.

A Boston manufacturer has now put an improved file on the market with an efficient locking device. The lower part of the holder contains studs or pins, which pass through the upper strip of the holder to which the locking device is attached. After the prints are in their proper position on the pins of the lower part of the binder, the top strip is put on and pushed down as far as it will go, by pressing on the curved end of a spring. The action of the spring exerts an upward pressure against the end of a tongue. This causes the edge of the oblique hole through which the hardened stud or filing pin passes to grip that pin firmly. To release the binder, the end of the tongue is pressed down so that it relinquishes its grip upon the stud. The top strip can then be lifted off.

He has no trouble in handling the largest blueprints with a holder and a few pins

Architects, engineers, builders and draftsmen who have had trouble with their files will do well to give this one a trial. It will come up to all expectations.

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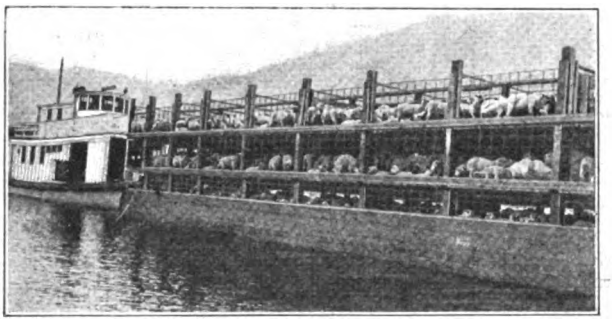
Taking Sheep to Pasture on a Giant Excursion Boat

WAY out in Washington State lies Lake Chelan. Its head is accessible only by rough, narrow mountain trails or by boat or canoe from the lower end. At both upper and lower ends there is fine grazing country. But it was absolutely impracticable to take sheep over the trails, although it had often been tried. Then came along officers of the United States Forestry Service. They looked over the ground, saw its possibilities as a summer pasture, and said: "Well, why don't you take 'em up by boat then?"



These sheep are on their way to pasture on a triple-decked barge that carries two thousand of them each trip

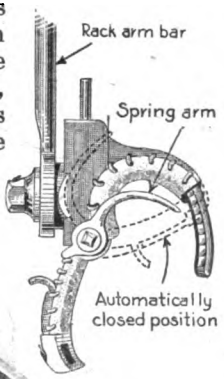
The outcome of this is the barge shown here—constructed like a New York scow, with three tiers of pens to accommodate the sheep. This barge is towed by a motor-boat.

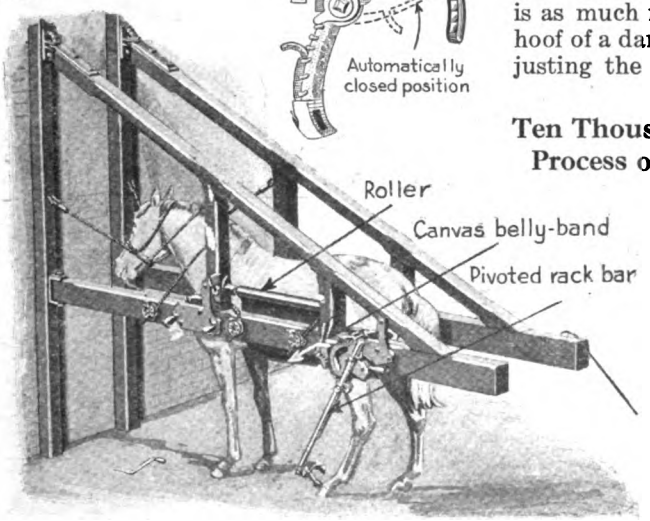
Still Another Apparatus for Holding Vicious Horses

IN the May issue of the POPULAR SCIENCE MONTHLY we published an article describing the apparatus constructed by the army farriers to counteract the evil designs of refractory horses. Here we have another contrivance, made for the same purpose, but of totally different design.

The main parts of this apparatus are two triangular heavy wood braces, hinged to the wall so that they may be folded flat when not in use. The horse is driven in between these and is just supported by a broad adjustable canvas bellyband.

For holding the horse's leg in position there is an arm which is movable to reach any of the four legs. It has a spring clip that grasps the hock, and the whole bar can be rotated or racked up and down, so that the hoof can be brought into the most convenient position. This mechanical feature is a great advantage, as there is as much risk in trying to pick up the hoof of a dangerous horse as there is in adjusting the shoe afterwards.





How can he kick while he is being shod?

Ten Thousand Dollars Offered for a Process of Making Mixed Oil Fuel

THE British Government has decided to offer a prize of $10,000 for a process of making a mixture of dehydrated coal tar with mineral petroleum oils suitable for Admiralty use as fuel oil. This will be awarded to the first competitor submitting a successful process which must be capable of ready and economical application without undue absorption of material and labor.

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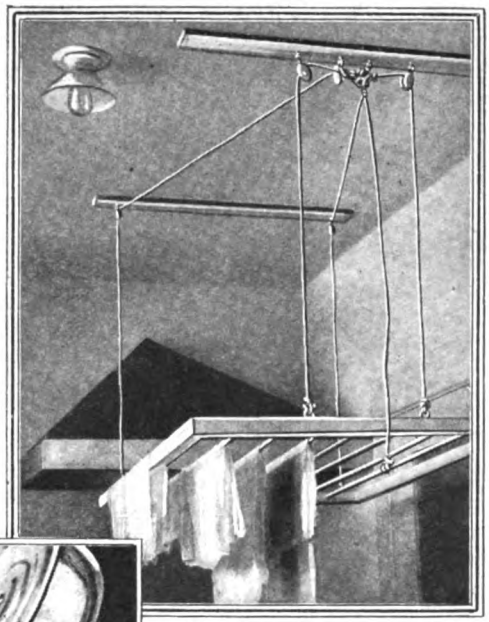
Housekeeping Made Easy with

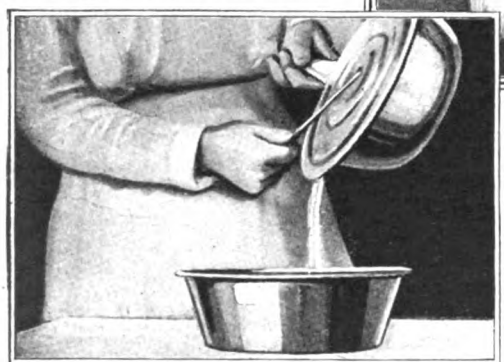
Humidifier with electric fan that will effectively and evenly distribute moisture in a room

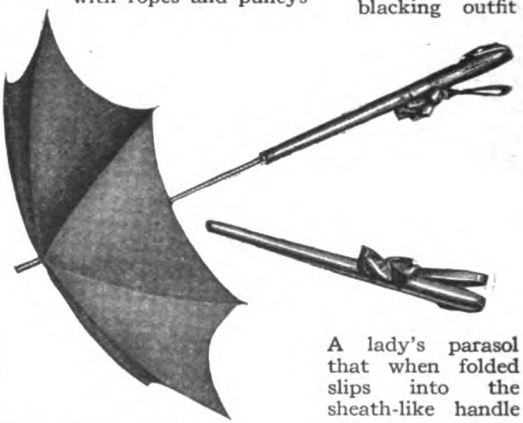


Frame for hanging clothes is suspended from ceiling with ropes and pulleys

A three-in-one kitchen article—a step-ladder, stool and shoe-blacking outfit

Utensil cover with long handle made to turn right-side-up when laid on the table

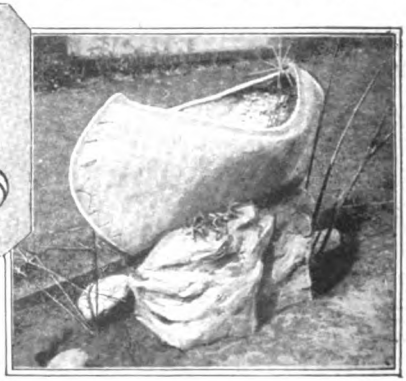




A lady's parasol that when folded slips into the sheath-like handle

A sewing machine attachment which is driven by the belt to sharpen knives

This doll is Jill—part of a quaint pair of Jack and Jill electric lights



Artistically arranged cement boat for the yard or garden

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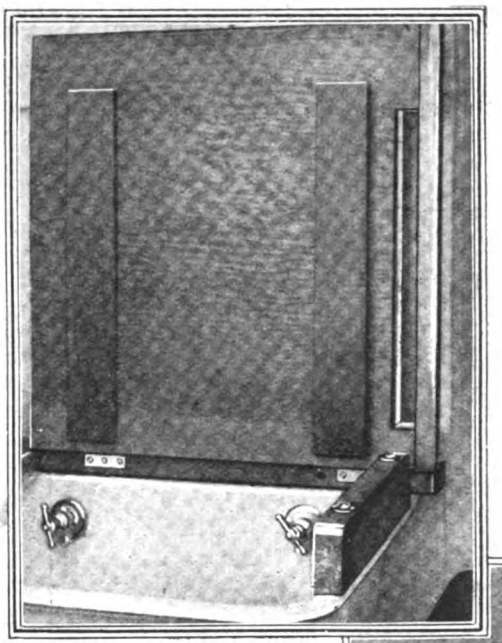
Mechanical and Electrical Devices

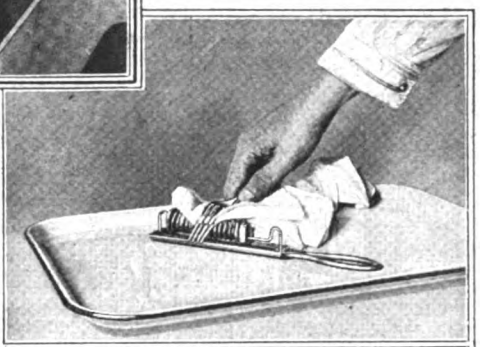
Long handle for the stoopless dust-pan

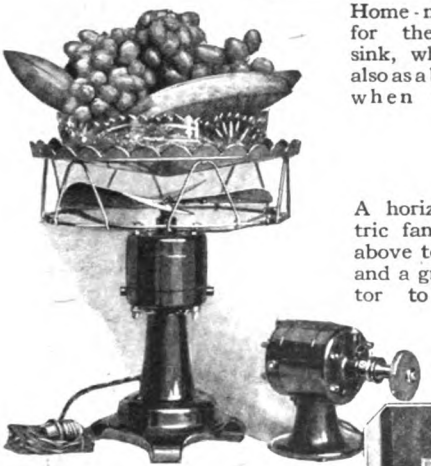


Home-made cover for the ordinary sink, which serves also as a bread board when let down

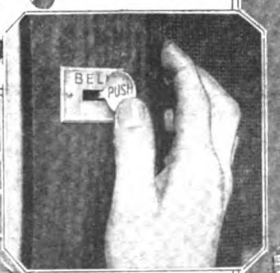
"U-say Uncle" statuette is used for a paper-weight

A coil of spring wire effective for cleaning forks with a cloth is shown below





A horizontal electric fan with tray above to hold fruit and a grinding motor to its right



A screen door catch which does duty as a bell-ringer when the door is fastened

An oxidized metal jar for holding twine is often useful and always ornamental

Cement flower pots with shapes like tree trunks for the garden

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Flowers of Tin That Need Neither Water Nor Sun

FROM putting tin on roofs to making artificial flowers that rival Nature's own is a far cry. Yet that is exactly what has been done by Robert J. Nimmo, who is a sheet metal worker in the Department of Construction of the American Museum of Natural History.

One day Mr. Nimmo saw a flower shop which had such an engaging display of daffodils in the window that his attention was arrested. As he looked at the flowers he thought he would like to make some just like them. But how? Tin seemed pretty stiff material out of which to fashion so delicate a thing as a flower. Yet tin was a substance Mr. Nimmo felt he thoroughly understood.

The flowers that bloom in the spring may be nothing but painted tin

When he got back to the shop he kept thinking of flowers of tin. At his lunch hour he tried his hand at flower making. Daffodils were fresh in his mind; so he started on them. During his spare moments he worked at the daffodils. Finally they were done, pot and all. Then Mr. Nimmo borrowed some paint and colored the flowers and the pot. When the job was done the daffodils appeared so natural that a person would have to look twice before he realized that they were only artificial.

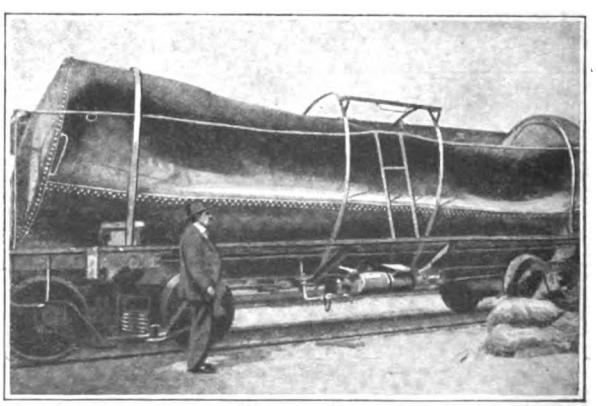
The Medium-Sized Oysters Make the Best Eating

MOST people are under the delusion that the largest oysters are the best. Mammoth oysters are served in good hotels and expensive restaurants at fancy prices, and the innocent consumer imagines that he has eaten something really choice. As a matter of fact, these bloated and pallid bivalves are poor eating. They cannot begin to compare with smaller oysters in respect to flavor or nutrient value.

Air (the Kind You Breathe) Pinched This Oil-Tank

EVEN a large steel oil-tank will not stand up against an atmospheric gas attack. Such a tank, with a capacity of eight thousand and eighty-five gallons, was being overhauled in San Francisco. It was planned to refill it with cocoanut oil; but first it was cleaned out by steam, a valve in the bottom being opened to permit the refuse to run out of the tank.

When the steam condensed a partial vacuum was created, which was enough to permit the atmospheric pressure (14.7 pounds to the square inch) to crush the sides of the tank as a large stone by its impact might damage a small tin can.



This is not a war relic. It is a steel oil tank crushed by the air—the kind you breathe

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Bumps and Hollows That Teach a Child How to Write Correctly

A PEN-HOLDER which is designed to aid in correcting the faults of handwriting in school children is shown in the accompanying illustration. The device is made of hard rubber and can be slipped over the pen-holder proper.

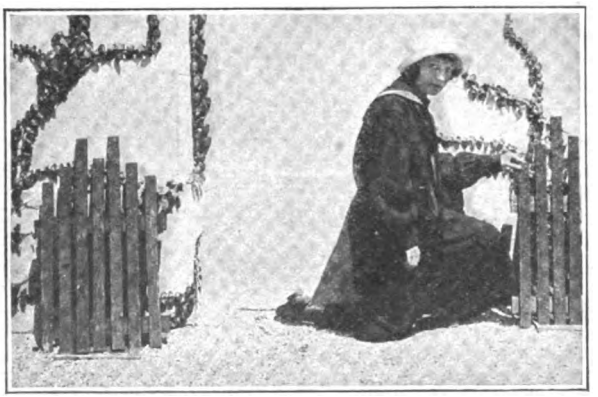
Three lugs or enlargements on the device enable it to be gripped firmly by the thumb and first two fingers of the hand. These enlargements are spaced about an equal distance apart, permitting the pen to be held not only in a proper position for writing, but in such a position that the letters and figures are formed in the right way. Anthony Borsella of New York City is the inventor of the device.

If we only had such a penholder when we first made "hen-scratches"!

Ornamental Lattice Protects Young Vines from Direct Rays of Sun

YOUNG Virginia Creepers and similar climbing vines must be protected from the direct rays of the sun until their growth is started and they become hardy enough to take care of themselves. Usually this is accomplished by hanging a piece of gunny sack, or some other unsightly thing in front of them.

Walter Reinhart of Los Angeles has devised a protection for young vines which is not at all offensive to the eye. Simple lattice shades are set in front of the vines until they grow sturdy enough to climb beyond the protecting shade. The lattices are made of laths stained a dark brown.



Lattices are used to shade porches. The same idea applies to young vines in the open

Planning a Diet for Weight Reduction

FUEL is the main food requirement of the body. A certain amount of fuel keeps the engines of the body working normally and produces energy. The surplus of fuel derived from the food forms layers of fat. So it is evident that the matter of keeping the body weight where you wish to have it is merely a matter of arithmetic.

Certain foods have an enormous fuel value in comparison with others. For instance, it would require nine dollars' worth of lettuce and tomato salad to furnish the amount of energy that thirty cents' worth of butter or ten cents' worth of sugar would supply. No one would think of feeding exclusively on any of these foods, but it is easy to see that the limitation of butter and sugar and the introduction of such foods as lettuce, tomatoes, celery, carrots, spinach and fruits, all of which have low fuel value, instead of fats, milk, cream and oil, pastry and sweets, would enormously reduce the fat-forming elements in the diet and yet fill the stomach and satisfy hunger.

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The Canary Birds of War

How they save our soldiers from suffocation by succumbing to gas

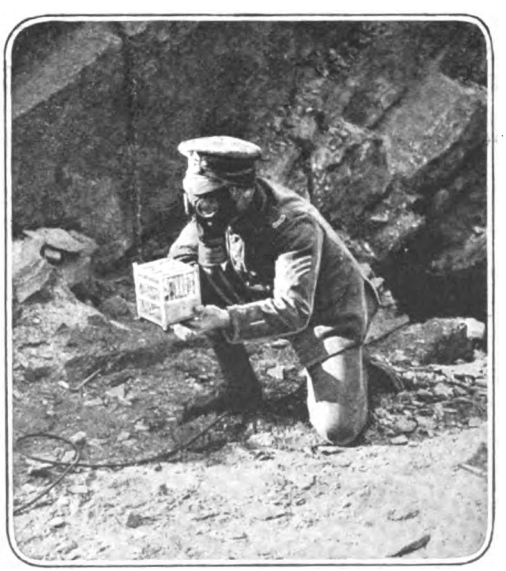
By John Walker Harrington

THOUSANDS of canary heroines were called to do their bits in this war as gas scouts in mine, and sap, and grim replacement.

As these feathered auxiliaries, although native to the Madeiras, have been bred by myriads in the Hartz Mountains, the Germans can draft all they need. The Allies, however, who have used them most, have drawn upon the scantier supply at Norwich, England, and the surrounding towns. General Pershing issued a call for three thousand, and part of the levy was met in this country. Miss Mary Garden, the opera singer, commissioned Royal Dixon, the naturalist, to rear several hundred for service "Over There." And other Americans sent consignments.

Only the female canary is fitted for military purposes, for she, not being a songstress, is not likely to betray her presence. It is only by accident that the male of the species gets to the firing line. "Billy, of the Trenches" is a rare bird.

One of the pathetic incidents of the war is centred about such a feathered minstrel who in some way escaped from his cage in the depths of a military mine. He alighted on a bush in No Man's Land and forthwith swelled his throat in a burst of melody. His roundelay revealed an important operation to the enemy and orders were given to fire upon his refuge. He continued to sing, all unconscious of his death warrant, and it was not until the bush was blown up by a shell, that his blithe minstrelsy was stilled.



Some battle gases, deadly as they are, cannot be even smelled. But the canary drops over just the same

The chief war use of the canaries is for the detection of the dangerous gases which form in all kinds of confined spaces after heavy explosions. The small cages containing them will be found therefore in saps, in the galleries of military mines which are being driven under the enemy, in concealed, well-camouflaged machine-gun emplacements, and in deep pits where mortars and heavy artillery are hidden.

In this respect, the canary serves the same purpose as she has in the American mines for years, where small birds and animals had long been utilized for the detection of the deadly fire damps and the after damps, the carbon monoxide and carbon dioxide which have cost so many hundreds of lives in the collieries of the United States. In fact, the term "gassed" was used here long before it became a common expression of the European War. The effect of carbon monoxide is about the same upon the human heart as are the bromine and chlorine and other diabolical mixtures introduced by the Germans. Some of these compounds can scarcely be detected by smell, or sight, but the carbon vapors which follow explosions in closed spaces are always the invisible and insidious foes of man. To the presence of these the canary is peculiarly susceptible. Hundreds of the birds in the stores of fanciers have succumbed to coal gas from a stove.

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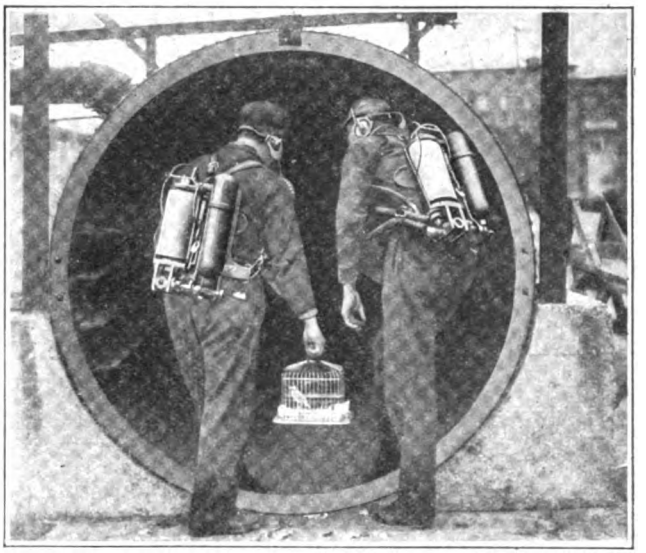
George A. Burrell, of the United States Bureau of Mines, locked himself up several years ago with various winged creatures, in an air-tight chamber having a capacity of eighty cubic feet. He then had enough carbon monoxide turned into the compartment to make one quarter of one per cent. of the atmosphere enclosed. Within a minute the canary birds were in spasms and in three they dropped in a faint from their perches. Pigeons withstood the stifling atmosphere for eleven minutes. Chickens took no notice of it. The scientist was forced to get out after twenty minutes. He suffered for three days from a severe headache.



Long before a miner feels the effect of gas in a mine a canary bird suffocates. That's why canaries are used as gas-alarms

Miners when on rescues bent carry with them small cages containing canary birds. They also have masks and on their backs are tanks filled with compressed oxygen. They have ample warning of the presence of damp and can soon protect themselves when they see their winged monitors show signs of asphyxiation. The soldier must act more quickly with his gas mask. The earlier forms of this protector, such as the Germans used, could be adjusted in about twenty seconds. The new British type can be donned in three.

Just as in some galleries of a colliery there may be explosions which bring on the rush of the unseen afterdamps, so in the branches of military mines driven for the purpose of hoisting the foe skyward, the firing of heavy charges is likely to send the carbon gases back into the network of tunnels.

In the earlier stages of the art of choking one's foes to death by means of poison gases, stories frequently came to this country of the use of canaries for the detection of the approach of the banks of vapor, launched on the favoring breeze. As the gases were usually visible and traveled so quickly that they were overwhelming to those not masked against them, the use of canaries for work in the open was hardly practicable. Where heavy gases traveled slowly and gradually sank in ditches or open cuts or communication trenches, it would be possible for the canary, so sensitive that it succumbs to a mere trace of injurious fumes, to betray the presence of a diffused gas.

Courtesy of British War Mission

Canaries were drafted for service in the British army soon after the first gas cloud was launched

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Soldiers often are apprised of the launching of a gas attack by the antics of small birds over the enemy lines. The lungs of a bird occupy a relatively larger space in the body than do the respiratory organs of most creatures, and although the canary is regarded as the most sensitive of the avine race to atmospheric pollution, other winged detectors have their value.

The military art develops over night, and the launching of gas attacks dependent upon the direction of the wind is giving way to the shell method. The gas shells are cylinders filled with compressed gas and provided with detonators which cause them to explode on impact. Such experts as Captain Noel Heaton, of the British War Mission, now in this country, testify to the extraordinary progress being made in the hurling of destructive vapors in containers from mortars. Soldiers these days have to keep their gas masks on most of the time during an engagement.

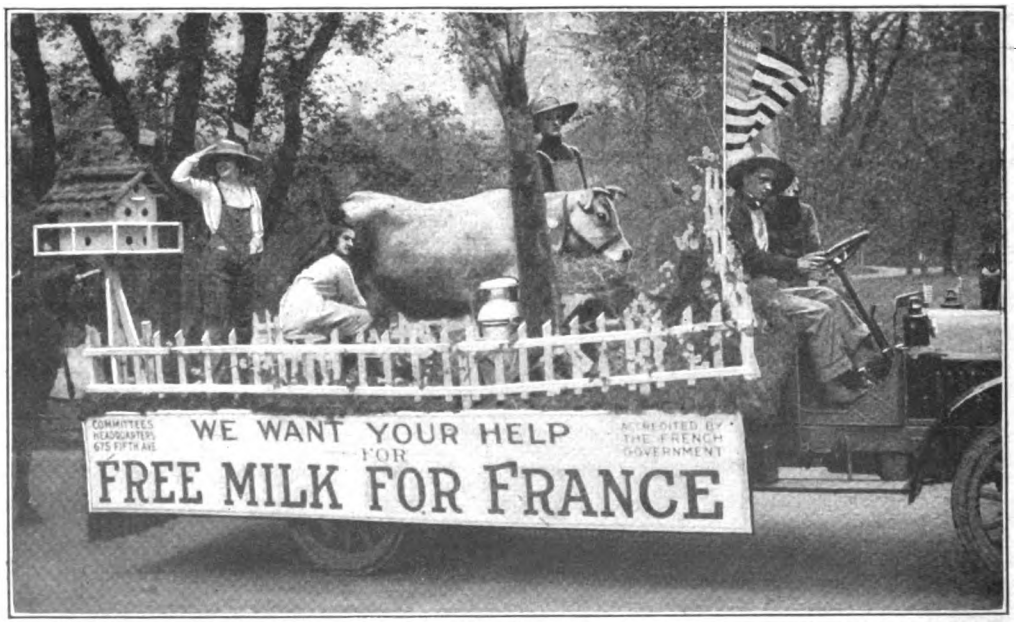
Fortunately the same science which invented the gas bombs also invented a a method of protecting the human organism against the injurious, often lethal effect of breathing these poisonous gases. The modern gas masks are efficient in nearly all cases.

Using Cottonseed Flour in the Foods of Man

ALTHOUGH the housewife may not be aware of the fact, it is likely that she is using cottonseed oil in some form as a food. This is due to the fact that it is contained in some of the novelties employed to replace fats longer known in cookery. Cottonseed flour, probably representing ground and bolted meal, is used to some extent in the foods of man.

Milking Cows on Floats to Raise Money for French Children

IN war times it takes the unusual to attract the attention of busy New Yorkers. But one day recently everybody on Fifth Avenue, Broadway and other crowded thoroughfares of New York paused to look in wonder when a number of floats carrying cows—real cows—and young women dressed as milkmaids appeared. The spectacle was a demonstration on the part of an organization formed to provide free milk for the children of France who have been deprived of it for a considerable time. As the floats passed along, the young women held out tin dippers into which pedestrians and persons in automobiles dropped coins.



Yes, the cow is real and she gives real milk. This dairy on wheels was used to induce New Yorkers to aid in supplying milk for French children who have long been deprived of it

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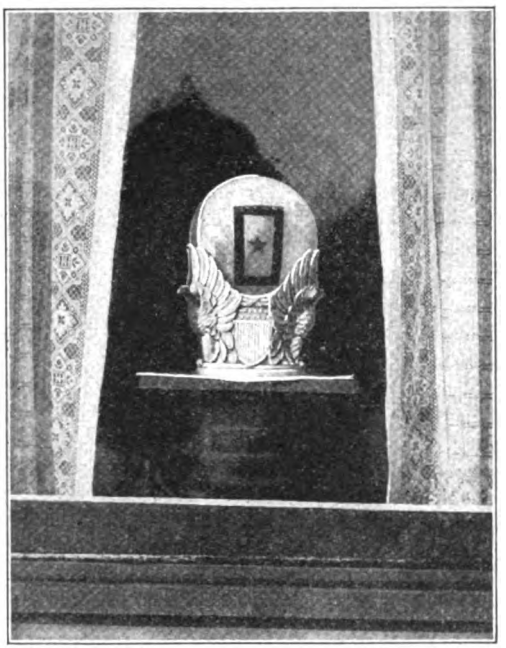
The Guiding Lamp in the Window Displays a Service Star

THE honor light, designed to serve the same purpose as the service flag, has been devised to be placed in the window at night. The light has a handsome imitation bronze pedestal consisting of two decorative eagle models that support an alabaster flat ball, eight inches in diameter. The design of a service flag, applied by a waterproof process, appears on the face of the ball. Blue stars can be attached to the face of the ball, as required, to show the number of persons in the service. The device is twelve inches in height and can be illuminated either by electricity or wax candles.



The honor light can be placed in the window after dark to take the place of the service flag which flies by day

Delivering Mail on Tricycles in a Great Electrical Plant

THE delivery of the shop mail in a big electrical plant in East Pittsburgh, Pa., has always presented a difficult problem. There are seventy-six acres of floor space and several hundred departments to be served. The rapid delivery of papers, drawings, etc., is essential, especially in these days when the plant is working on Government orders, turning out engines for motors for ships and airplanes.

The old method of delivery by boys on foot proved inadequate long ago. For several years small electric trucks have been in use. But these trucks, satisfactory as far as mail distribution was concerned, proved to be uneconomical. They represented a considerable amount of invested capital and required the services of two grown men. They have now given place to a much less expensive but fully as efficient a system in which boys on tricycles are the feature.

These tricycles are similar to those ordinarily used by small merchants for delivering light packages. A metal box, fastened in front, contains twenty-two small compartments for papers and three large compartments for packages, rolls of blueprints, and other bulky parcels.

The tricycle solves the problem of mail delivery in large electrical plant

A Collapsible Boat for a Submarine's Use

A SHORT time ago a man was landed on the Irish coast from a German submarine. The man was arrested by British officers and the boat in which he had reached the coast was seized. It was a collapsible canvas boat, about eight feet long, two feet wide and twenty inches deep. Wooden slats formed the bottom. The sides lined with rubber, when inflated, greatly adds to the boat's buoyancy.

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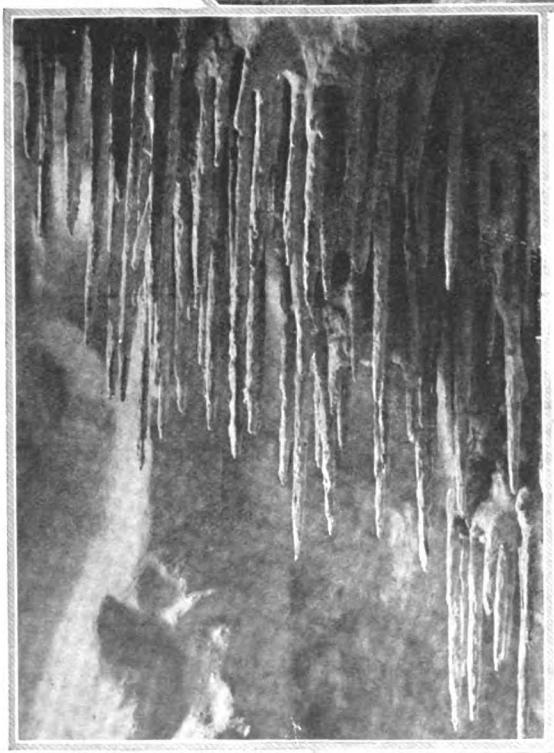
Building Imitation Alps of Rocks and

Every well regulated Alpine garden must have a rocking stone. This shows the carefully balanced imitation at Friar Park

This picture gives a good idea of the great size of the rocks used in making the Alpine garden. A total of 7000 tons was required



The picture in the center above shows the great rock representing the peak of Matterhorn just put in place on its foundation of chalk. This particular rock came from the top of the real Matterhorn. The rest came from Yorkshire

The trees which form the setting for the remarkable Alpine garden at Friar Park, Henley-on-Thames, England, created at great cost by the owner, Sir Frank Crisp, were transported by means of a specially constructed wagon shown below

Under the artificial glacier is an equally artificial ice cave with counterfeit stalactites that look like icicles

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Concrete on an English Nobleman's Estate

One of the rock basins fed by the torrents rushing down the miniature Alpine valley

Giant blocks of rock, tons of them, were piled up as the framework of the garden

The general view of the Alpine scene, with the miniature copy of the Matterhorn in the background and the labyrinth of rocks, covered with gorgeous Alpine flowers, in the foreground, is charming

The snow and ice on the Matterhorn peak is imitated by pulverized Derbyshire spar. The Alpine flowers, profuse in the spring and summer, grow right up to the snow line

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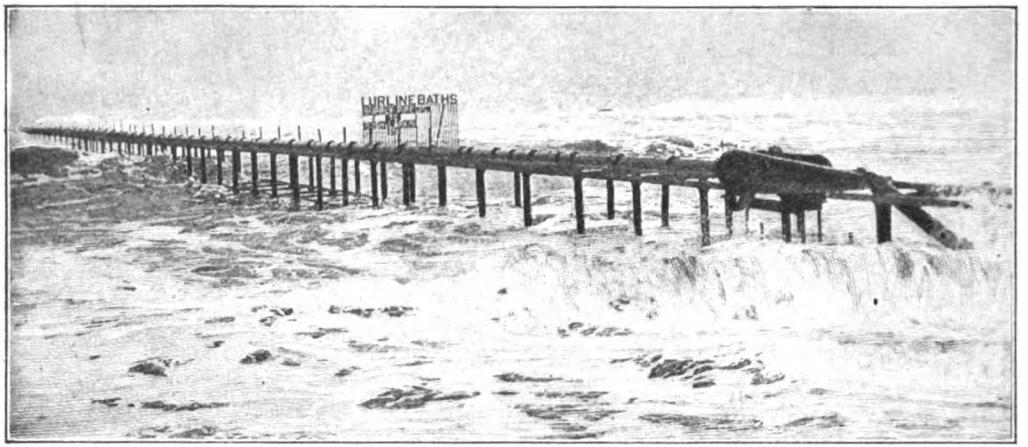


The intake of the six-miles long pipeline through which San Francisco obtains its bathing water is one thousand feet from the beach, where the water is deep and clear

How San Francisco Pumps Bathing Water from Pacific

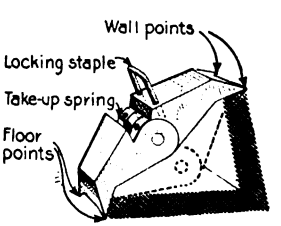
SAN FRANCISCO uses vast quantities of salt water in scores of her large public bathing establishments. To conduct this water from the Pacific into the city a powerful steel bridge has been erected, which extends outward from the beach to a distance of one thousand feet. On this a huge iron main is laid. Some distance inland is a pumping station. The water is conveyed by a pipe line, about six miles long, into the heart of the city, from which point it is distributed.

A Brace to Bar Your Door to Burglars

A DEVICE for securely fastening a door opening inwards in case the lock should be out of order or as an additional protection against intruders was invented recently by Dr. Harry B. Roberts. It consists of two metal parts hinged together to form a knee joint. At the free end each of the two parts has a sharp edge with two prongs. When the brace is to be used, it is placed against the lower rail of the firmly closed door so that the prongs of the other end rest on the floor and the knee joint buckles outward, away from the door. Then the middle part is pushed toward the door, until the knee is completely straightened. By this straightening the span is lengthened and the prongs are pressed deeper and more securely into the wood of the door and the floor. To prevent the knee from buckling, a staple is provided, which firmly locks the two hinged parts when the knee is fully extended, similar to the manner in which the lock pin fastens a pulley to the shaft. A spring between the hinged ends of the brace maintains the pressure of the ends of the brace against door and floor. This makes it impossible to loosen the brace by shaking the door.

The only possible objection to the device that we can see is the unsightly holes it makes in the wood.

Pushing down the knee joint straightens the brace and pushing down the staple, locks it



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A Miniature Fort for Every Soldier

He can carry it with him when he goes out to lick the Germans

A MAN down in the well-known city of Myrtle, Miss., has evolved a truly beautiful modification of the many portable breastworks and bullet stoppers, in that he has added to this laudable effort, also a battery of revolvers, making the whole merely a miniature Maubeuge or Namur.

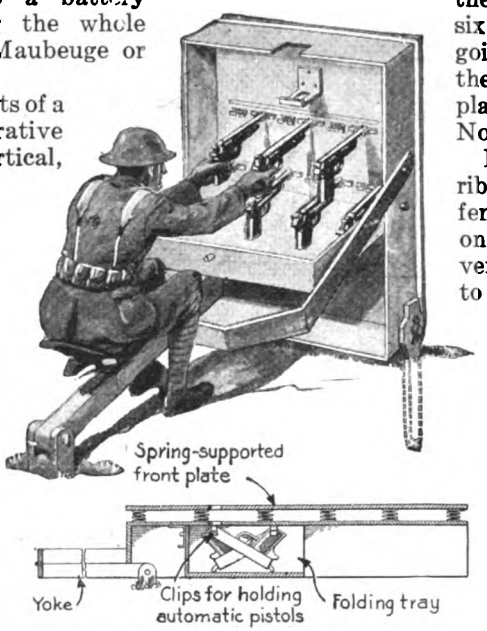
The invention consists of a steel plate that in operative position, stands vertical, staunchly facing the foe. This plate and also the decoy plate in front of it are pierced with port-holes for the revolvers which are mounted in battery behind it. The decoy plate, located a short distance ahead of the main plate, is backed by coil springs. This is one of the important points. What happens?

Sit back and hold tight while we tell you that the springs back of the front or decoy plate are compressed by the blow of the bullet fired by incautious Hans or Fritz, whereupon the recoil of the springs hurls back plate and bullet, promptly smiting said Hans or Fritz on the rebound, with his own bullet!

With the breast-work raised to its vertical position, covering two soldiers, there appear, swinging from their clips, with their muzzles pointing grimly through the port-holes as the carronades of Bainbridge pointed through the sides of the old "Constitution," six revolvers, which the inventor says are "preferably of the automatic type." He doesn't know that automatic revolvers outside of a freak type built years ago in England, are largely figments of the inaccurate newspaper man's imagination, automatic pistols being more generally used. Still this inventor specifies automatic revolvers, and we let him have his way.

Let an incautious Teuton dare to stick so much as a finger from his shelter, and the two soldiers start the six automatic revolvers going, something like the Swiss Bell Ringers playing The Chimes of Normandy.

If, in spite of this terrible instrument of defense, the foe still insists on coming over, the inventor has arranged it to fold down flat on the ground, the revolvers pivoting to lie out of the way, and the whole covered up by the then prone decoy plate. The inventor calls attention to the fact that in this position it is not in the way of retreating troops. What would they be doing out ahead of such a fort? Echo does not answer.



The upper picture shows the portable fort in use. Below is a diagram showing its ingenious construction

The device is said to be light and easily carried. Imagine any one lugging a little steel fort that can resist mauser bullets!

The inventor says that these portable breastworks are really intended for use during a retreat. The troops can stop at any point, erect these breastworks and open fire on the enemy by means of the revolvers. Alas! he does not state what happens if the enemy unfairly stops 300 yards away, beyond which pistols are not accurate. He fails to mention one very great advantage of his shield, during a retreat. Here it is: So long as the troops continue to carry them there will be no danger of their breaking into a run and turning the retreat into a rout.

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Surrender Quickly When You Face This Armored Car

"HOLD up your hands and cry 'Kamerad,' or I'll shoot!" cries a boyish voice, as you approach the house. Coming down the path you see a miniature armored car, moving rapidly toward you. The only occupant, a little boy in military uniform, tries to look his fiercest as he looks at you from behind the formidable machine-gun which is pointed threateningly at you.

Perhaps you hesitated a trifle too long in obeying the command—the little soldier's hand gives a turn to the gun-crank in front of him and with a vicious "Ra-ta-ta-ta" the gun begins to spit imaginary bullets in your direction.

Some day this kiddie may operate a "sure enough" armored car against the enemies of his country

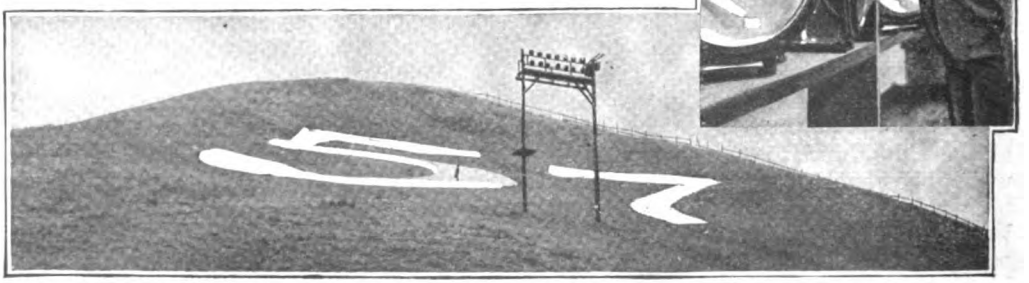
The little boy is glowing with excitement and pleasure. He has vanquished the enemy who refused to surrender and with a joyful "Hurrah!" he runs his armored car to the other side of the house in quest of other enemies.

The armored car shown in the picture is mounted on a tricycle frame and carries a big gun in front and a few smaller guns on each side. A spring snapping over cogs produces a noise like that of a machine-gun, when the crank is turned. Toys of a martial character are always extremely popular with boys and the great war, naturally, has increased the interest of the kiddies.

And the Mountains Arose and Cried "57 Varieties!"

AS one travels through the countryside of Southern California, impressed with the grandeur of the scenery and marveling at the wonderful sweeps of mountain and valley, a number looms up like a nightmare on a distant hillside—a familiar and dread number that recalls stifling street-cars and crowded subways. t glares white on the side of a distant mountain. At night the haunting number stands out in ghostly radiance on a ground of velvety black.

What are we vaporing about? Merely the magical, well advertised Number "57." It has been sunk in immense concrete figures on a California mountain side. A battery of electric lamps illuminate it at night. This immense sign can be seen ten miles away. There are "57's" throughout Southern California, and they tell their story at all times but still are blotches upon the landscape.



Do you see that dot on the "5"? It's a man. And the frame between the "5" and the "7"? That supports a battery of lamps to light up the numerals and so make night hideous

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Fifty-Seven Ways of Sleeping in This Mechanically Adjustable Bed

PERHAPS it isn't poor digestion that makes you spend sleepless nights tossing about on your bed; it may be that all you require are new positions for your head and feet. In that event the bed shown in the accompanying illustrations will fulfill the requirements, for the operation of its mechanism will place the sleeper in fifty-seven different positions.

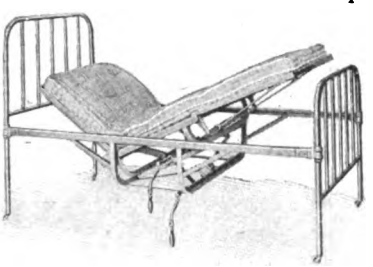
Giving patient a comfortable position by simply turning the crank

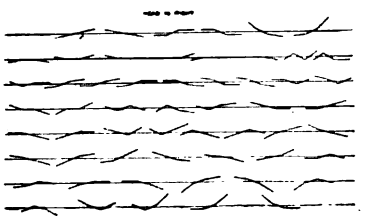
It was designed primarily for hospital use and for the comfort of convalescents in the home, but is manifestly well adapted for Sunday lounging also. Its advocates point out that it will induce sleep in the weary when the straight-back bed has failed to do so.

The multi-position bed is constructed like an ordinary bed, except that its springs are on three panels which can be moved up and down and adjusted to various angles by cranks. These cranks can be turned by the occupant of the bed unassisted. As soon as the crank stops moving, the panels which it governs are locked in the position desired. These panels can be moved until they touch the floor or are placed in vertical positions.

The operating mechanism is of simple construction, containing no ratchets, latches or insecure fastenings and the frame is doubly trussed.

It will occur to many that this mechanism can be readily adapted to surgical uses. The surgeon's operating table, as we know it, does not allow changes of position. This device will more than satisfy requirements anywhere it is installed.





Above: one of the positions which may be given to the bed. Below: a diagram showing the fifty-seven different positions possible

There's Little Hope of Conquering the Clothes Moths

DR. RALPH C. BENEDICT, an eminent chemist and student of entomology, about four years ago undertook a careful and systematic study of the clothes moths with the aim of solving the problem of moth-proofing ordinary woolen fabrics. Dr. Benedict accumulated a mass of the most interesting information concerning the life and activity of the various clothes moths during the various stages of their development and made numerous experiments to ascertain the effect of many poisonous substances on the eggs, the larvae and the mature moths.

In the resumé of his researches which Dr. Benedict published recently he holds out little hope of conquering the winged pests which cause so much damage to furs and woolen materials. He finds that remedies intended for the flying-moth stage are worse than useless. So-called repellants, such as tobacco and cedar, did not repel or harm the moth in any stage. The same may be said of other strongly odoriferous substances. Kerosene and gasoline fumes were not effective. Camphor and naphthalene in closed places kill all stages. The eggs and larvae turn from whitish to a yellowish brown in color and the larvae cease their activity almost immediately. Strange to say, the larvae lived for weeks on cloth soaked in corrosive sublimate without showing any discomfort. It does not take more than a grain of the stuff to kill the strongest man.

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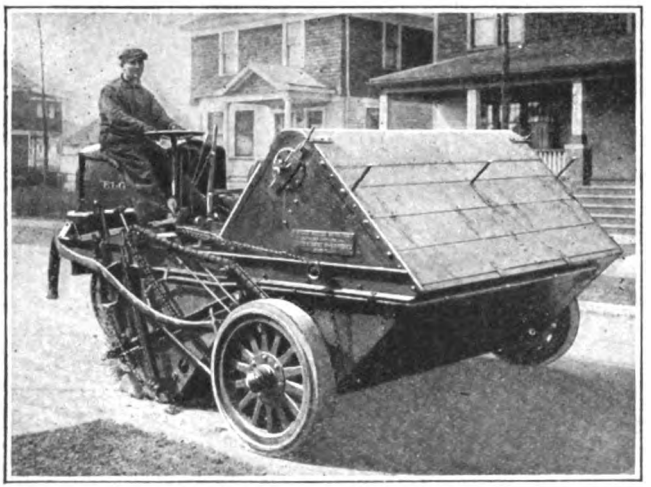


First it sprinkles the street, then it sweeps, and finally it gathers the dirt up and carts it away—all mechanically

It Wets, Sweeps and Carries the Dirt Away. One Man Runs It.

A MACHINE that is able to do the work of four horse-drawn sweepers, and clean the streets at a cost of only seven cents per thousand feet is shown in the accompanying illustration. This machine is equipped with an eighty-gallon water tank, under a sixty-pound pressure, which is located at front and which sends the water onto the pavement through four nozzles. Thus the dust is wetted before the eight-foot brush at the rear end gathers it in. A conveyor carries the sweepings to a large box in front, which has the capacity of two ordinary wagons.

The power is supplied by a forty-horse-power engine in the rear, and connected with this is an air-pump which produces pressure for the water tank. A chain-and-sprocket arrangement revolves brush and conveyor.

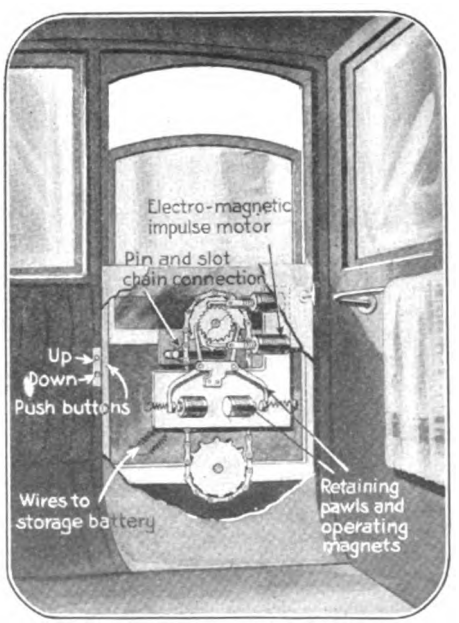
Warm? Push a Button and the Window Opens

IMAGINE yourself leaning back against the swelling cushions of your luxuriously equipped limousine. It was cool when you started and the windows of the car were closed. But now it is warm, uncomfortably warm, and you long for a breath of fresh air.

What was it that the genial demonstrator for the automobile concern said about opening and closing the windows? — "To open the window, press on button No. 1 and keep your finger on the button until the window is down as far as desired. To close the window press on button No. 2 and continue the pressure until the window is raised to the desired point."

You press the button. The window opens and you bless the inventor of the mechanism, Harry Emery Norwood, of New York.

The entire apparatus is concealed between the panels of the carriage or automobile door. A chain running over two sprocket wheels, one right beneath the window, the other lower down, raises or lowers the window. It may move in either direction and is connected with the lower part of the window frame by a stud. The upper sprocket wheel is attached to two ratchet wheels, the teeth of which are arranged in opposite directions. Pawls, actuated by electro-magnets, act upon one or the other of these ratchet wheels, when an electric circuit is established by



If you want to open or close the window, push the button!

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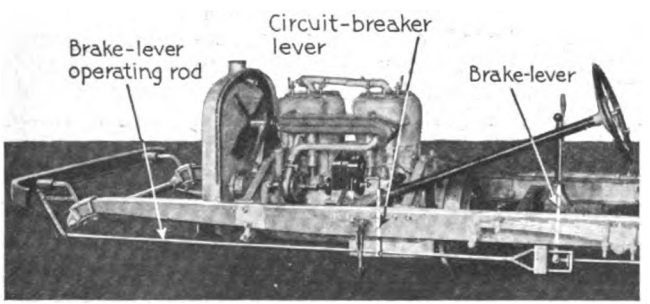
the pressing down of the corresponding button and impart to that wheel a step by step revolving motion. This motion is communicated to the sprocket wheel and through this to the chain. As the chain moves in one or the other direction, the stud, by which it is connected with the window frame, will raise or lower the window, as the case may be. Two locking pawls, operated by another set of electro-magnets, normally lock the two ratchet wheels, thus preventing any change in the window's position.

For Excitable Car Drivers

THE man in an automobile who hits a pedestrian usually loses his head. He becomes so excited that he fails to apply his brakes or shut off the engine. In addition to being knocked down the pedestrian is run over. Clifford W. Cole of Camden, N. J., comes to the poor pedestrian's rescue with a type of fender which automatically applies the brakes and shuts off the engine when the fender strikes.

In congested traffic like this drivers are apt to lose their heads and injure others

An ordinary fender mounted on springs is carried on two brackets on the spring horns. A small bar, near one end of the bumper, is fulcrumed on one bracket and has its lower end connected with a horizontal rod extending longitudinally under the car frame to the brake lever where it is fitted with a yoke that operates the brake lever, so that the brakes are applied when the rod is given a forward motion as the bumper strikes. In the middle of the rod, a pivoted vertical circuit-breaker is attached and provided with a contact at its upper end. As the rod moves forward to apply the brakes, the contact is pulled away from its seat on the spark plug wires leading from the magneto to the cylinders and the circuit thereby broken, stopping the engine immediately.



When the fender strikes something it stops the engine and hence the car—so that it can't run over anybody

Gasoline as Dangerous as Dynamite

MANY automobile owners do not fully realize the danger connected with the careless handling of gasoline. In a general way they recognize the explosive power of the liquid, but few of them know how great that explosive power is. A writer in one of the magazines devoted to the automobile trade seeks to make this clear and more impressive by comparing the explosive power of gasoline with that of dynamite. He points to the fact that gasoline, even at low temperature, constantly develops an explosive vapor. Five gallons of gasoline will generate 8,000 cubic feet of gas, which, if ignited, expands 4,000 times. One gallon of gasoline, properly mixed with air and compressed, is equal to about 83 pounds of dynamite in explosive force. What makes gasoline particularly dangerous is the fact that it is more rapidly ignited and exploded than dynamite. One can never be too careful in handling gasoline under any and all circumstances.

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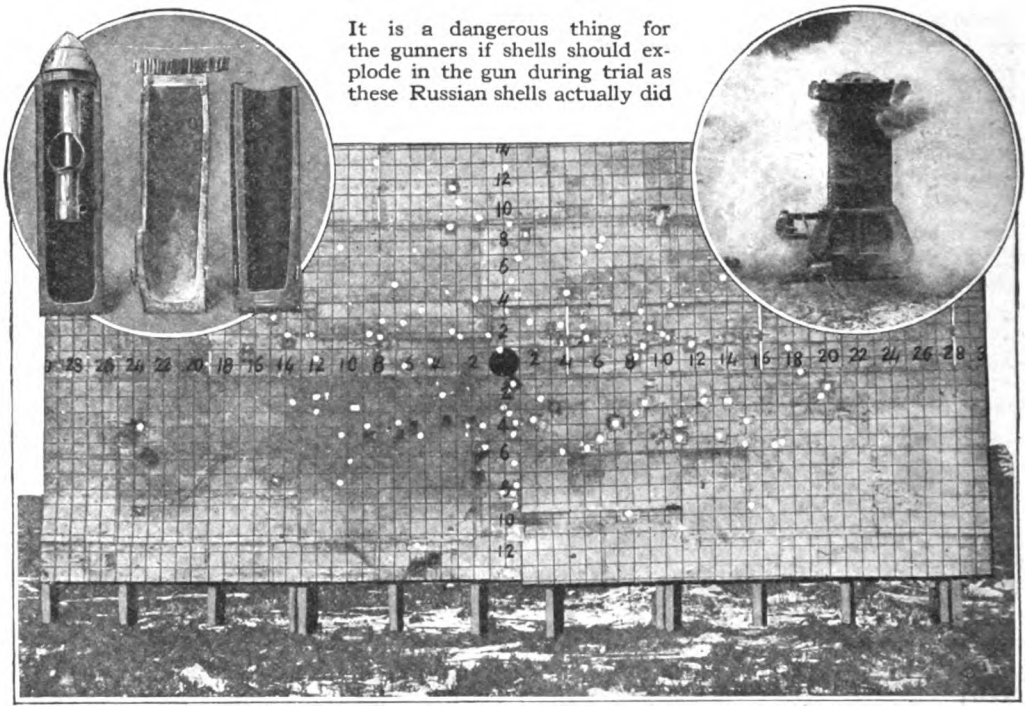
Exploding "Duds" by Electricity

Shells which have failed to explode are fired by electric sparks to find out their defects



In the circle on the right is shown how unexploded shells are exploded in a bursting pit on the Eddystone Range, Lakehurst, N. J.

Forty out of forty-two shots fired from a field gun hit this target at the Eddystone Range at seven thousand feet distance

DO you know what "duds" are? In the military slang which has developed during the great war a "dud" means a shell which shirked its duty by refusing to explode. Many of these shells are picked up after every artillery attack, and they constitute a source of danger, because they sometimes explode unexpectedly while they are handled.

When ammunition is tested on the proving grounds of the Eddystone Range at Lakehurst, N. J., the shells which fail to explode are carefully collected by "shell-scouts" and brought to the testing pit for defective shells. The "duds" are exploded by an electric spark in a steel pit provided for that purpose. By this method the experts are able to determine which particular feature of the shell was defective.

Before the shell is fired, the small door at the bottom of the pit is opened. The shrapnel and other contents of the shell are hurled through the door by the explosion. This relieves the pit of a considerable part of the force of the explosion, and prevents the ultimate congestion of the pit.

Sometimes the shells burst in the gun during the firing tests and it has happened many times that the gun was destroyed by the explosion. One of the pictures shows some of the Russian shells which exploded in the gun during the test. Another picture shows a target in the proving grounds which was used to try out Russian shells and guns at a range of 7000 feet.

The distances at which the shells tested were timed to explode were 7000 feet, 10,500 feet, 14,000 feet and 17,500 feet, The records were made by photographing the shells as they exploded.

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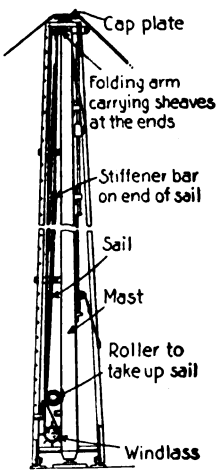
The Labor-Saving Sail-Raiser

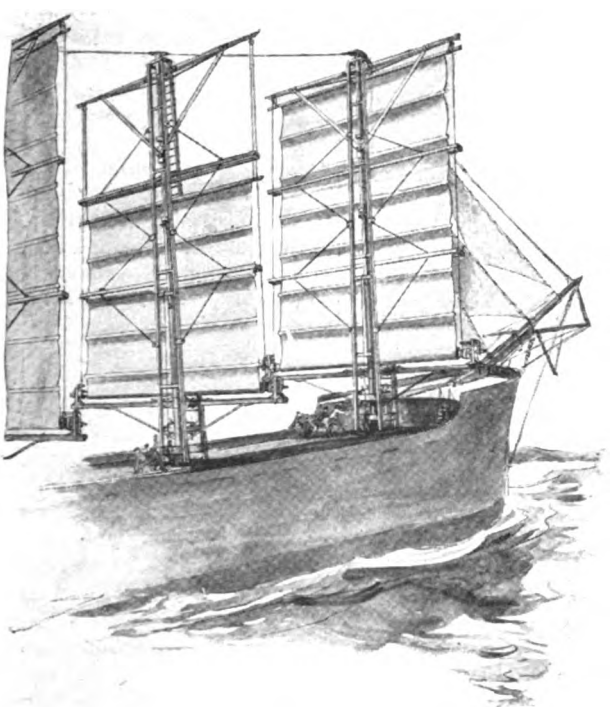
A sail-raising device that lightens the labor of the crews of wind-jammers

IT was in 1862, when rounding Cape Hatteras in an army transport, that E. W. Brown, then a soldier in the Union army, realized the hardships of a sailor in raising and lowering sails in stormy weather. Although now in his seventy-eighth year, he has only recently patented a sail-raising and lowering device by which he expects to reduce the crew of a sailing ship from four to twelve men. The device is particularly designed for square-rigged ships.

A ladder-like structure or tower is fastened to the mast or masts. Each mast is pivoted with its lower end on a pin, immovably secured to the deck by means of a bolted plate. The upper end of the mast is pivoted in a plate which is held in position by guy ropes or cables. The entire structure is revolvable on the pivot and may be stayed in any position by bolting the side pieces of the ladder to brackets of which a number are fastened to the deck in suitable places around the pivoted mast. This arrangement makes it possible to set the sails at right angles to the direction of the wind and to hold them in that position at will.



The sail, when not in use, is wound around a roller at the base of the tower. It can be hoisted or lowered by a cable running over a pulley near the top of the mast and worked by a windlass. To keep the canvas of the sail taut guide cables are provided which are attached to the ends of the top yard of the sail, run over pulleys at the end of the top cross-arm of the tower and back to the sail roller. The cable is there wound around a conical drum which tightens the cable as the sail is let out. If so desired, the top yard of the tower may be folded against the mast by means of a toggle joint.



A distinctive feature of this device is the ladder-like tower that is fastened to the mast

Huns Drop Bombs That Light Up the Landscape

GERMAN aviators in recent raids on Paris used a device like a rocket, with a clock movement. The bomb on exploding releases a linen parachute equipped with a cartridge containing a substance with a magnesium base. This is lighted automatically about 1000 feet above the ground and casts a strong light over objects below it for two minutes.

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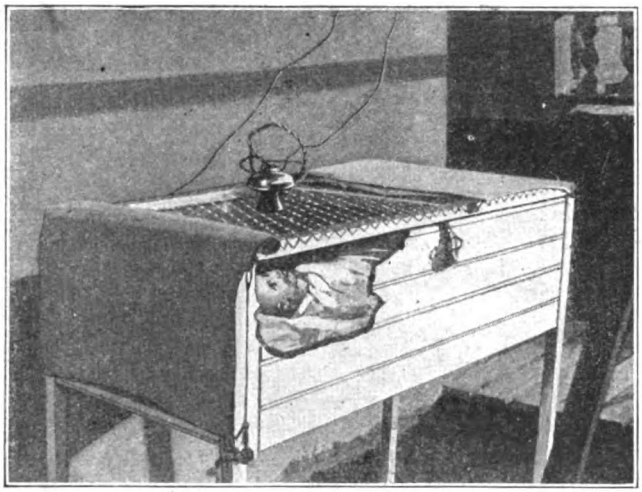
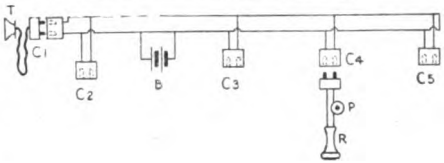


When the baby in its crib on the roof is crying, the mother can hear it in the telephone. The diagram shows the wiring. Note the transmitter fastened near the baby



How Crying Babies Summon Their Mothers by Telephone

MANY modern city apartments have no yards, and even if they had, it is a long way down from the upper stories. How is the baby to get the several hours a day out of doors so necessary to health?

I solved the problem for myself by building a crib on the roof. But the baby's mother, anxious as all mothers are, was impelled to run up on the roof about every five minutes to see whether baby was crying.

To obviate these frequent trips to the roof I rigged up a telephone system between baby's crib and the apartment. A standard transmitter was fastened on some wire netting stretched over the head of the crib and a receiver placed down stairs in the apartment. The two were connected with bell wire and operated on two dry cells. In order to save the batteries a push-button was located in the circuit by the receiver.

Now all that mother has to do is push the button and listen in the receiver to hear whether baby is crying.

A piece of flexible twin conductor is used at the transmitter, terminating in an ordinary plug connector so that the transmitter can be easily removed in stormy weather or at other times when not in use.

The device proved so effective that it has been extended to other apartments in the building occupied by friends. When mother goes visiting she puts the transmitter at the baby's crib, takes the receiver with her and plugs it in at her friend's apartment.

On Saturday nights several of the families in the building get together for cards, when all their babies are put in one apartment containing the transmitter.

Ingenuity and Concrete Save a Flagpole

WHEN a one hundred and ten foot flagpole in Central Park, Los Angeles, became wobbly, a resourceful city engineer reset it in concrete. Props were set around the pole to hold it securely while workmen excavated to a depth of four feet around its base. In the bottom of the excavation a ring of ten-foot piles were driven around the bottom of the staff. Then concrete was poured in and moulded around the pole as shown in the picture. The concrete cone rests on the piles.

It only cost $32 to construct a concrete base for this flagstaff in a Los Angeles Park

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Thirsty? Take a Drink from the Fern Ball in the Garden

EARTHEN jars sufficiently porous to keep their surfaces moist, and thus cool the contents by evaporation, are commonly used in Mexico and throughout the southwestern sections of the United States. These jars are known as ollas.

By wrapping such a jar with floral moss to a depth of five inches, binding it in place with copper wire, and covering the moss with growing maiden-hair ferns, Herbert C. Goudge, prominent Los Angeles lawyer, has secured a most beautiful as well as useful article for the adornment of his Japanese garden. The walls of the jar are just porous enough to keep the ferns fresh and the water at a delightful temperature for drinking. This water will not yield in coolness to that of the "Old Oaken Bucket." It only requires a poet's pen to make it popular. Moreover, the cost of the completed ornament is trivial when compared with its beauty and utility. The capacity of the jar is five gallons. In the picture below the young lady has just dipped a cooling draft from the jar, which nestles in a mass of ferns.

Porous earthen jar, covered with moss and ferns, supplies cool drinking water

"Island of Safety" in Chicago where Garfield Boulevard and S. Michigan Ave. intersect

Proper illumination would have prevented this untoward accident

Unsafe "Safety Islands" and How to Make Them Safe

PARADOXICAL as it may seem, there are such things as unsafe islands of safety, those little havens of refuge for the pedestrian who has to cross a busy street and finds himself hemmed in by the criss-cross traffic. The "unsafety" of these "islands" lies in the circumstance that many of them are not properly lighted at night, and the motorist, confused by the glare from his own headlights, is liable to run into them. One of the accompanying illustrations shows just such an accident. The other picture, showing an intersection of two residential streets in Chicago, demonstrates how such islands of safety can be made more serviceable by surmounting them with strong arc-lights. A still better method is suggested, namely, that of having the post or pillar surmounted by a red globe, below which is a cluster of white lights that throw a powerful illumination on the base of the "island." With such a light to warn him no autoist will have any excuse for running into the pillar.

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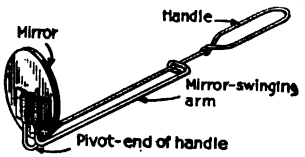
Looking at the Other Side of Things with a Mirror

PIPES, pipes, and some more pipes; long and short, straight and crooked pipes; they run in every direction and form a perfect maze between the condensing tanks and boilers.

Two men, one the superintendent of the plant, the other, judging from his appearance, some kind of mechanic, have picked their way through this jungle of pipes in the dim light filtering through the distant basement windows. They have reached a point near one of the big up-



You Can Make One for Yourself

A light and small mirror with a tin back is hinged to a wire handle of desired length. Another wire, provided with a sliding loop, so that it may be moved back and forth along the handle of the mirror, is also hinged to the back of the mirror. By manipulating this wire, the mirror may be swung around its axis to any desired angle

right condensers, but are barred from further progress by the network of pipes.

"The trouble must be right back there," says the superintendent, "but I don't see how you'll ever be able to find out what is the matter, unless we take down all these pipes."

Without saying a word, the other man takes two objects out of his tool bag. One of the objects, in the form of a tube, proves to be an electric torch, the other consists of a double wire handle with a small bright disk set at right angle to the wire, attached to the bent end.

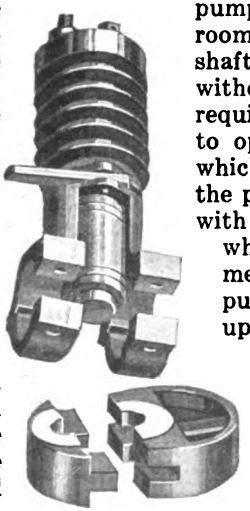
Holding the torch with his left hand, the man reaches with his arm between the pipes and turns the powerful light of the torch upon the rear side of the condenser. With his right hand he manipulates the wire handle in such a manner that in the mirror at the other end he can see the part in the rear of the condenser which the torch effectively illuminates. In a few minutes he has located the trouble and ascertained its cause. It is then easy to apply the remedy.

You Can Blow Up Germans or Grow Vegetables with Nitrogen

NITROGEN enters as a vital element in the making of various explosives, and without it many destructive articles could not be manufactured. On the other hand, nitrogen is indispensable to man's chief source of food supply—namely, plant life. In the form of ammonia, this gas is applied to the soil as a chief ingredient in fertilizers.

Compact Air Pump for Your Launch

OWNERS of gasoline launches or other power boats may be interested in an unusually clever air pump which has recently been placed in the market. The pump is compact, takes very little room, is worked by the propeller shaft to which it may be attached without taking out the shaft and requires no appreciable extra power to operate it. An eccentric cam, which is split, fits tightly around the propeller shaft, so as to engage with the piston of the air pump which is fitted to the shaft by means of hinged journals. The pump will fill a ten-gallon tank up to sixty pounds pressure in about ten minutes if the propeller makes 450 revolutions a minute. A pump of this kind is extremely useful for pumping air with which to work the whistle or to draw the bilge water which gets into the launch through leaking seams.



No extra power needed to run this air pump

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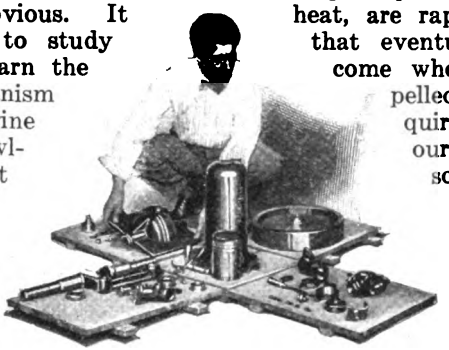
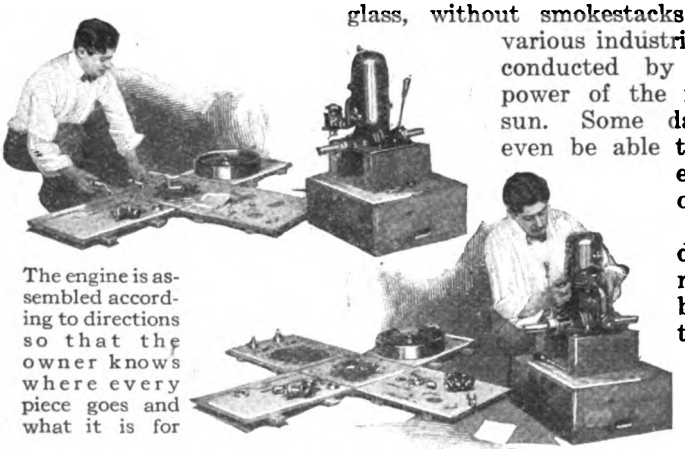
Get Acquainted with Your Engine by Setting It Up Yourself

THE advantage of putting together his own engine, after a man has bought it, is obvious. It gives him the chance to study its construction and learn the part each piece of mechanism performs when the engine is in operation—knowledge invaluable when it comes to cleaning it or making adjustments and necessary repairs from time to time. The manufacturers of a certain kind of engine, principally intended for motorboats, have adopted a novel and taking method of familiarizing purchasers of their engines with their mechanism and at the same time reducing the cost as a special attraction. They ship the parts of the engine, carefully numbered and securely fastened in a folding box, which, after being opened, can be laid out flat on the floor. Following closely the printed directions, the purchaser of the engine detaches one part after the other from the supporting boards of the box and puts them together in the manner prescribed. The various parts are machined to snap-gage accuracy. If set up in accordance with the printed directions the engine will be found to be in perfect order. By assembling and mounting the various parts of the mechanism the owner becomes thoroughly familiar with it and with its working, and he also has the satisfaction of having saved a considerable percentage of the price. In case it fails to work he can have the fault remedied at once.



The engine reaches the buyer with its parts fastened in a folding box and carefully labeled and numbered



The engine is assembled according to directions so that the owner knows where every piece goes and what it is for

Will the Sahara Furnish Power When Coal Gives Out?

IN view of the fact that coal and wood, the principal sources of artificial heat, are rapidly diminishing and that eventually the time must come when we shall be compelled to derive the heat required in our homes and our industries from other sources, a discussion of the possibility of finding such new sources is of intense interest. Professor Giacomo Ciamician of Bologna, an eminent Italian chemist, in an address before the Eighth International Congress of Applied Chemistry pointed out that in six hours the sun would deliver in energy taken direct from its rays the daily power value of 2,500 tons of coal on every square mile of desert land. In the United States about six hundred million tons of coal are mined annually. The desert of Sahara alone receives every day in solar energy the equivalent of six billion tons of coal. He stated that great progress had been made already toward the utilization of direct sun power. He prophesied that in time tropical countries would be thickly populated and that on their arid lands would spring up great industrial centers where, in buildings of glass, without smokestacks or smoke, various industries would be conducted by the direct power of the rays of the sun. Some day we may even be able to get along entirely without coal.

When that day arrives it may not even be necessary to dig for coal or to worry about the supply or price of it. The sun will supply the world directly with heat and power for all purposes.

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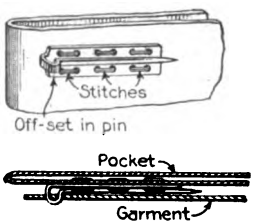
This Pocket Can Be Attached Almost Anywhere You Please

FOR the convenience of campers and soldiers in the trenches a detachable pocket has been put on the market that can be fastened to a horse-blanket, or the inside of a coat, or, in fact, anywhere that is convenient. The pocket is complete in itself and is fastened to the desired piece of cloth by four metal clips that penetrate the cloth and are bent over to hold it in place. The free ends are tucked back so that they will not stick in anything.



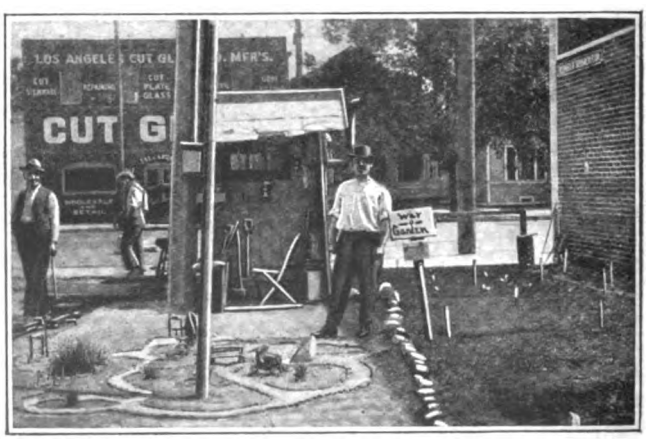
A pocket when and where you want it

At the Tail End of the Earth's Glacial Period

DR. Marsden Manson of San Francisco, an eminent authority on geology, points to the fact established by recent antarctic explorations, that the great ice cap covering the region of the South Pole is shrinking. From this he draws the conclusion, that the gradual subsidence of the Age of Ice, of which the polar ice caps are the existing remnants, is still going on and that we live, so to speak, at the tail end of the glacial period. He expresses the conviction that the same succession of geological climates has prevailed in antarctic as in other latitudes and says that the evidence collected in recent antarctic explorations is corroborated by the comparatively recent uncovering of temperate land areas, and the progressive retreat of the snow line to higher elevations in temperate and tropical latitudes and toward the poles at sea level. He comes to the conclusion that the disappearance of the Ice Age is an active present process and must be accounted for by activities and energies now at work. He considers it as proved that the rates and lines of retreat are and have been determined by exposure to solar energy and the temperatures established thereby; and by the difference in the specific heat of the land and water hemispheres.

A Switchman Is a "War Gardener" When He Is Not on Duty

THAT a man can be a switchman and a "war gardener" too has been demonstrated by George J. Budman of Los Angeles. He was anxious to start a "war garden," but as he lived in an apartment he could not have one at home. However, he did not give up the idea and at the crossing where he is stationed—one of the most dangerous in Los Angeles—he found a plot of ground about twelve feet in width and twenty feet in length, which was close to the switchman's working quarters. This he turned into a "war garden." He is now successfully growing a number of vegetables, and is happy in the knowledge that he is "doing his bit."



It was only a twelve by twenty plot of ground, but George J. Budman made a war garden of it when he wasn't switching trains or watching the crossing

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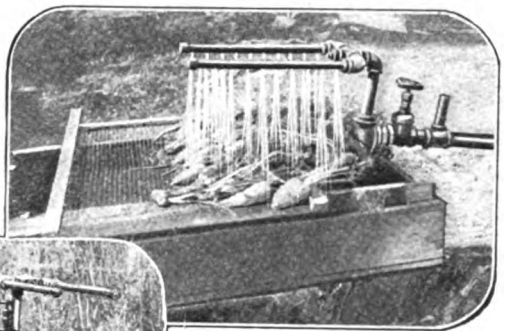
Converting Garbage into Chicken Feed

MR. WILLIAM H. FAUST, of Los Angeles, has recently patented a process for converting garbage into poultry food. The garbage is sorted, and wood, tins and other inedible articles removed, together with the large bones. The remainder is then cooked with steam for about four hours at well above the boiling-point of water. The large bones are ground up and mixed with the rest in the cooker. Then superheated steam is turned into a steam-jacket which surrounds the cooker for ten or fifteen minutes to sterilize the contents, after which they are thoroughly dried. In this condition they are put in a grinder and coarsely ground. The resulting foodstuff is laid in windrows to absorb moisture from the air, and is then ready to feed to poultry and live-stock. When this stuff is mixed with bran or middlings a well-balanced ration is the result.



Under ordinary water pressure the spray will thoroughly cleanse the vegetables

This shows another practical form of the device for washing vegetables

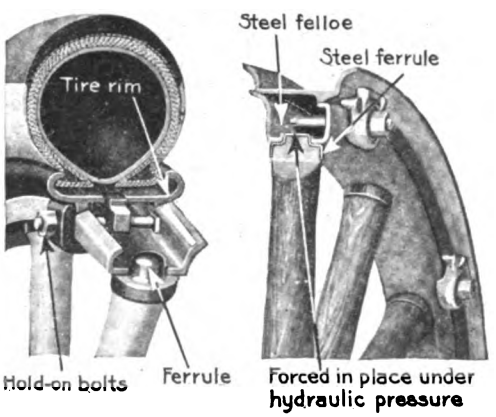
Washing Vegetables in Bunches for the Market

IT is perfectly natural that vegetables brought to market covered with dust or mud are not as salable as those presented to the purchaser in a clean and fresh condition. Many gardeners on a small scale lose a good part of their profit because they neglect to wash their vegetables before bringing them to market. Why? Because of the difficulty which the washing of bunched vegetables presents and the time it consumes.

A home device which overcomes this difficulty is shown in the accompanying illustration. Two half-inch pipes, each with one or more rows of small holes drilled into them on one side, are set parallel to each other in a two-armed reducing joint attached to a water-pipe. The two parallel pipes are closed at the free ends by caps. When the water is turned on it escapes through the holes in a number of fine but powerful streams which thoroughly clean the bunched vegetables.

Steel Instead of Wood for the Felloes of Automobile Wheels

STEEL instead of wood is now being used in a certain measure for the bands connecting the outer ends of the spokes of automobile wheels. This is due to the difficulty of obtaining properly seasoned hickory. The outer ends of the spokes are capped with steel ferrules to afford protection from water, the spokes being forced into the felloes under hydraulic pressure. Because of the large quantities in which the steel bands can be manufactured their use makes the cost of the wheels less than when wood is employed.



Using steel as a substitute for wood for the bands connecting outer ends of automobile wheel spokes

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A Windmill That Dodges a Kansas Cyclone

FUNNEL-SHAPED clouds chase one another about overhead, portending a heavy wind storm. Two men driving by a field in which is a pump operated by a windmill commented on the shortcomings of such apparatus.

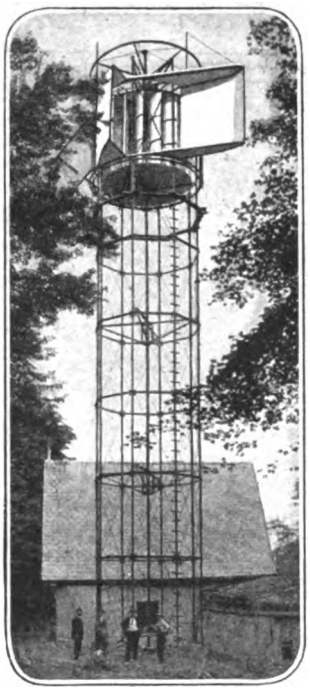
"The trouble with windmills," says one of the men, "is that you can't depend on their standing up under a gale. Now just watch."

But the expected did not happen. For when the storm broke, the wheel of the mill automatically slid to the base of the tower. Thus the witnesses to this operation learned of the invention of a windmill which could defy the destructive force of the power that operated it.

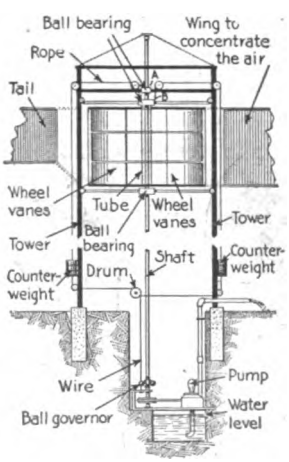
At the top of the tower was a cage which carried two vanes and a rudder. An inner cage, to which was attached a number of vanes, received the force of the wind directed against them by the outer cage, the vanes on the outer cage always turning the same faces to the wind.

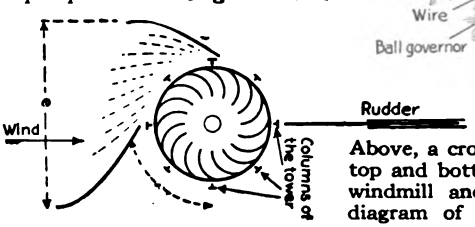
The wheel was attached to a tube suspended by ropes passing over pulleys at the top of the tower. The tube was made to slide along a shaft extending the length of the tower and operating the pump. A key attached to the shaft gripped it to the tube. The pulley ropes passed through a drum connected with a ball governor, the wheel in descent being kept in near equilibrium by weights attached to the ropes on each side of the tower.

When the force of the storm struck the vanes on the wheel and revolved the shaft at more than full speed, the ball governor released the brake on the drum, permitting the tube carrying the wheel to descend to the ground. The weights served to regulate the speed at which the wheel descended.



This windmill is more powerful than the ordinary windmill of the same diameter





Above, a cross section of the top and bottom parts of the windmill and to the left, a diagram of the wind wheel

The Chance of Death in an Air Raid

WHEN an airplane flies over a city, dropping bombs indiscriminately, it is natural to consider a certain area within a definite radius of the bombs' explosive force as dangerous. A writer in a French periodical has recently given some figures that tend to show the comparative destruction of life wrought by these aerial missiles; and he comes to the conclusion that density of buildings and population increases the effectiveness of bombs dropped at random. Consequently, he asserts, the dangers are twice as great in Paris as in London. In open spaces, he figures from actual statistics, the chance of danger is one in 150,000, while in a well-built house it is but one in fifty millions. These figures are for London and based on the casualties in that city during recent air raids.

But, after all, figures won't remove the fear of death. There will, in all probability, always be some persons who regardless of assuring statistics, shall prefer to seek real or imaginary safety in cellars and dugouts.

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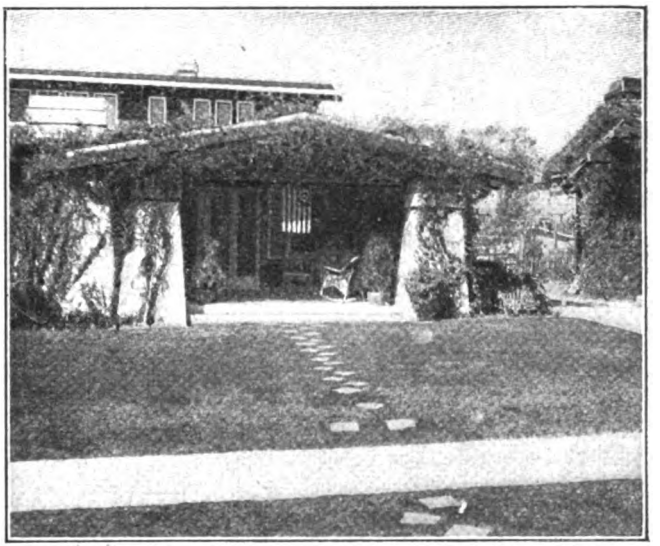
Millions of Horses and Mules in the War

MOTOR vehicles are used extensively for war purposes, but they have not entirely displaced horses. According to a statement by the British Premier Lloyd George, the British alone employ 2,000,000 horses in their armies. 5,000,000 horses and mules are in service on the West front. Many a ship-load of mules and horses has gone from this side across the "pond" to our allies in France and England.



From the sidewalk you walk to the porch over square concrete slabs or stones "accidentally" dropped in place

A Curb That Protects Parkway Flowers

A CURB to protect the flowers and shrubbery growing in a parkway before a home from heavy rain torrents is shown in the accompanying photograph. The parkway is located on the side of a hill. Every rain-fall caused a flood of water to run over the street curb on to the parkway, sweeping away or inundating the growing things in its path. This having occurred several times the owner of the property decided on the extra curb as a means of prevention.

The curb is located at the upper end of the parkway, at an angle to the grade off the street, so that when the water rushes down the gutter and washes over the street edging it strikes the extra guard and is driven back. The curb is about nine feet in length, six inches in thickness, and from six to twelve inches in height. It is made of concrete with a smooth finish to match the sidewalk.

Since this extra curb was put in place the flowers have not suffered from rains.

This extra curb of concrete was built to protect parkway flowers from inundations

Tiptoeing Your Way Across the Lawn on Stones

A NOVEL approach for the small home is made entirely of stepping stones—a pleasing contrast to the ordinary solid-concrete approach to a bungalow. This place is located in Pasadena, California, in a neighborhood enjoying a number of unusual features, among the most unique of which is this approach.

The concrete stepping stones or slabs used in this approach are 12 by 12 inches in size and are placed in an irregular manner from the sidewalk in front of the house to the front porch, giving them the appearance of having been "dropped" in place, rather than "laid" there. A few slabs have also been dropped between the sidewalk and the curb as the accompanying picture on top of the page shows. These slabs are four inches in thickness with a smooth finish on the upper side to match the sidewalk and the porch floor.

—ALBERT MARPLE.

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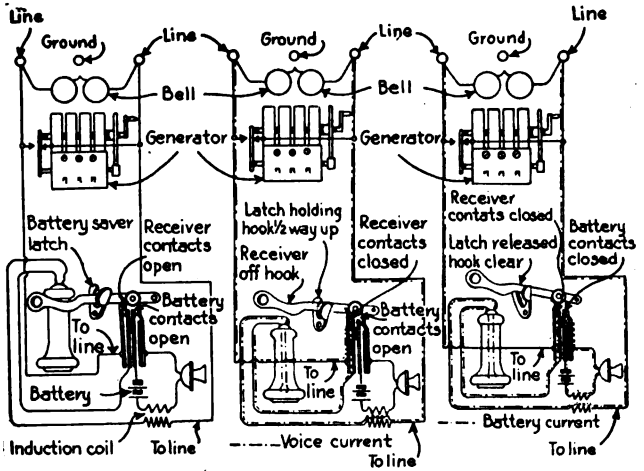


This diagram shows the wiring of a rural party-line and the effects of the "battery-saver" when duly attached

Let Joy Be Unconfined! the Farmer's Wife Can Now "Listen In" All She Likes

"BR-R-R-ING! B-r-r-r-ing! B-r-r-r-r-r-r-r-ing!!"

"Oh my, that's Mrs. Simpson's call. I must hurry and listen in, and see what the news is up our way this morning."

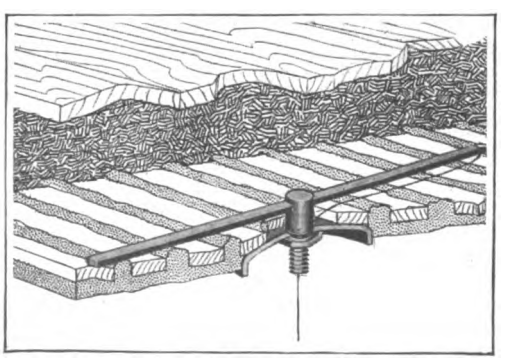
And the farmer's wife rushes to the telephone, and there hears all the news of the neighborhood. But all this is hard on the batteries. Every time any subscriber takes his receiver from the hook, he cuts in his local batteries, and they soon become exhausted.

An eastern telephone manufacturing company has devised an attachment which does away with battery wastage. It consists simply of a little latch, called a "battery saver." This is intended to be mounted on the outside of the telephone case in connection with the receiver hook. When this attachment is in use, taking the receiver from the hook to "listen in" simply cuts in the receiver alone. If one wants to break in on the conversation he pushes on the latch and thereupon the hook flies up another notch and the batteries and transmitters are cut in also, as well as the receiver. One can therefore both talk and hear, just as if the attachment were not present. But in the fact that it keeps batteries cut out except when wanted, the attachment renders an unusual service, and one likely to make it popular among party-line users. In fact it is the best aid to gossips we have seen in some time and imparts zest to rural life.

A Simple Economy Hanger for Wiring Old Buildings

THE wiring of old buildings, always a difficult and often an expensive matter, is made much easier and less expensive by a new work hanger recently invented and placed in the market. This device consists of a stud with a screw thread at the lower end and a square hole through its upper part. A bar fits into the hole.

To put the device in place, a hole is made in the plaster of the ceiling, large enough to admit the stud. The supporting bar is pushed into the square hole of the stud, so that the stud is near one of the ends of the bar. A wire leader is attached to the other end of the bar. The bar is pushed through the hole in the ceiling, at right angles to the direction of the laths. After the stud too has been pushed through the hole with its upper part, the wire leader is used to pull the supporting bar through the hole in the stud, so that the stud is in the middle of the bar. Then the outlet box is slipped over the threaded part of the stud and fastened securely by a lock-nut. This entirely obviates the necessity of having unsightly conduits on the ceiling and walls of the room.



A stud with a thread at its lower end and a bar in its upper part makes it easy to wire old buildings

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Just a Piece of Sheet Iron and You Have a Camp Stove

HERE is a valuable stove idea for the camper, especially if he owns an automobile. Although it has been tried out and found satisfactory, its simplicity will cause its value to be questioned by many. It consists of a single piece of sheet iron 1/8 in. thick, 18 in. in width and 24 in. long. It can be purchased at any hardware store.

This piece of metal serves as the top of the stove only. When camp is to be made stones are gathered and arranged in two piles, these being placed at the desired height and the proper distance apart; then the iron top is placed on them and everything is ready for cooking. If no stones are at hand, which is seldom the case, a hole with sloping ends may be dug in the ground and the top of the stove placed over it

He dug a hole and laid a piece of sheet iron across it. The result was a camp stove

Two noteworthy features of this stove are the convenience of handling and lack of weight. It does not weigh more than 10 lbs. and, if carried in the machine, may be placed beneath the rug in the bottom of the car so as to be out of the way when not in use.

Starting Induction Motors When Coils Fail to Work

ALMOST all alternating current fans have starting coils that are automatically thrown out of circuit by a centrifugal device when the motor operates rapidly. Sometimes this device becomes deranged and does not break the connection, with the result that the fan fails to attain full speed and becomes overheated.

In a case of this kind where parts cannot be secured quickly to make the necessary repairs, the two ends of the starting coils may be connected to a piece of flexible cord and a push button connected to the other end to hang down within easy reach. To start the fan it is only necessary to turn on the current and hold the push-button down for a moment and the fan will immediately pick up speed, after which the button may be released. This kind of a repair may be made on any such motor where the starting coils are thrown out automatically when a certain speed is attained by thearmature. New parts should be procured as soon as possible to replace the makeshift starting circuits—JOHN D. ADAMS.

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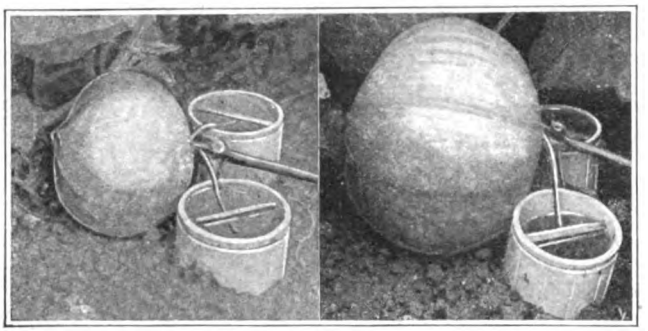
Injecting Water Into Vines to Make Pumpkins Grow Rapidly

PUMPKINS, vegetable marrows, etc., usually grow at a great rate; but their development may be hastened to an astonishing degree by feeding them through the stalk with plain water. Holes are made in the stems of the fruits and into these the ends of lamp wicks are pushed as shown in the photograph. The other ends of the wicks, which are preferably rounded, rest in jars of fresh water. The fruits seem to swell up as soon as they are connected with the water, and are ready for cutting in half the time. In this way individual plants can be made to bear much more heavily as the fruits tax the resources of their parent to only a small extent.—S. LEONARD.



Jars of water placed at the pumpkin stem for feeding it. The second picture was taken three days later

Drying Potatoes for Future Use Instead of Storing Them

IF the American housewife allows any waste or fails to put aside a generous supply of summer products for winter use it will not be because she has not been admonished and shown how by the Department of Agriculture. The latest exhortation is of special interest to those having too little storage space to accommodate the surplus potato crop.

Formerly the only thing to do with the white potato was to make a place for it in the cellar. But this year there will doubtless be double and triple the amount of potatoes for storing. This seems to be an argument in favor of the drying method.

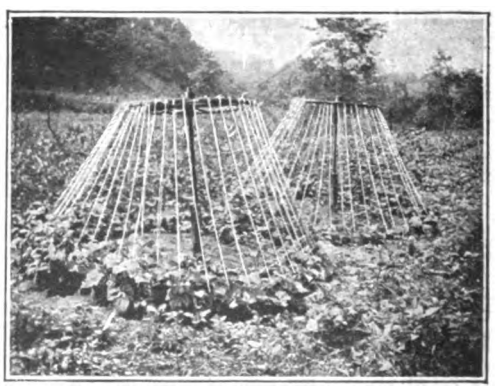
To be dried, potatoes must first be partially cooked. First peel them, cutting out all eyes and spots. Then cut into 3/16-in. slices and rinse in clear cold water. Arrange on wire trays in an ordinary home steamer, such as was described in the October issue of the POPULAR SCIENCE MONTHLY, and steam for fifteen minutes. The thicker the slices, the longer they must be steamed. When the potatoes are under-done the centers turn dark on drying and may mold quickly. New potatoes do not need to be steamed quite as long as old ones.

The steamed slices may now be placed on trays in front of an electric fan and the moisture driven off by a current of air of room temperature, or they may be placed in an oven heated to approximately 160°F. and dried until brittle. The former is the easier way if electric fans and current are available.

The dried potatoes should be stored in tight containers and kept in a dry place. Pasteboard boxes, paper sacks, or containers made of paraffin fiber, fastened to keep out bugs and other kinds of insects, are satisfactory and inexpensive.

Old Buggy Wheels Used for Training Growing Vines

A PERSON that took a great deal of pride in his small backyard garden used some old discarded buggy wheels for training his bean vines. Each wheel was supported by a substantial post with



Buggy wheels mounted on posts with strings from the rims to make vine trellis

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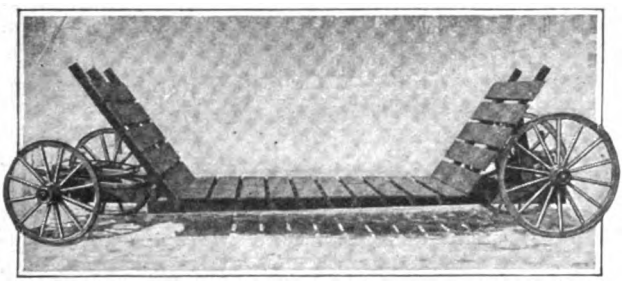
its upper end hewn down to fit in the hole in the hub. Stakes were driven in the ground in a circle of larger diameter than that of the wheel rim. Strings were then run from the stakes to the wheel rim and the beans planted near the stakes.

The vines climbing up the strings made a frustrum in appearance. At harvest time the beans are easily gathered from either side of the vines.

An Underslung Rack for Hauling Green Corn Fodder

BY those who are using the high flat rack for hauling the long, heavy bundles of green corn fodder to the silage cutter this underslung rack shown will be much appreciated. The expense of building such a rack is not to be considered in measuring its convenience. If boards are lying around or taken from a building torn down there will be no cost other than the time for making the rack. To save time and avoid mistakes the rack is best made on a common wagon running gear of the regulation size.



The framework of this rack is hung under the level of the axles to make it handy for loading the fodder

The frame should be made of 4 by 6-in. material, 18 ft. long, bolted together in front and fastened to the underside of the front bolster with a long king bolt and nut. It is well to have an iron plate on the underside of the timbers for a bearing. The rear ends of the timbers are placed as far apart as possible and fastened to the underside of the rear axle with U-bolts. A 2 by 6-in. piece 7 ft. long is placed crosswise of the timbers just far enough back to allow the front wheels to turn easily and is bolted to the timbers.

The end guards need not be over 4 ft. high and braced as shown. Braces may be run from the 4 by 6-in. timbers up to the 2 by 4-in. pieces of the rear guard and the front guard may be braced by spiking the bottom of them to the timbers and allowing them to rest on the cross piece at the front.

Such a rack saves energy hitherto used in loading and is excellent for handling woven wire, green corn, fodder, posts and detached hog houses.—GUY S. ELLIS.

Removing Static Charges from a Moving Belt

TO remove the heavy static charges from a moving belt, the hangers, bearings, etc., are usually grounded. It will, however, be found advisable, in addition to such grounding, to install metal combs in the under side of the belt close to the point where it leaves the revolving pulleys, and also to treat the outside surface of the belt periodically with a mixture of equal parts of water and glycerin.

The generation of this static charge of electricity seems to be brought about by some internal movement of the particles or fibers of the belt structure, and the charge appears to be equally strong along the whole length of the belt. It is very little affected by increased tension, or slipping of the belt. Since the material of which the belt is made is usually a non-conductor of electricity, in order to dissipate the accumulated charge, it is necessary to render it conductive. This result is best accomplished by the use of metal combs and the application of water and glycerin as described.—PETER J. M. CLUTE.

Making Transparent Varnish of White Shellac

DISSOLVE one part of pearl ash in about eight parts of water; add one part of shellac and heat the entire mixture up to the boiling point. When the shellac has completely dissolved, cool the solution, and saturate it with chlorine until the shellac precipitates out entirely. When it is redissolved in alcohol, it makes a varnish which is as transparent as any copal varnish, and more satisfactory for a large number of purposes. This is a trade secret worth knowing.

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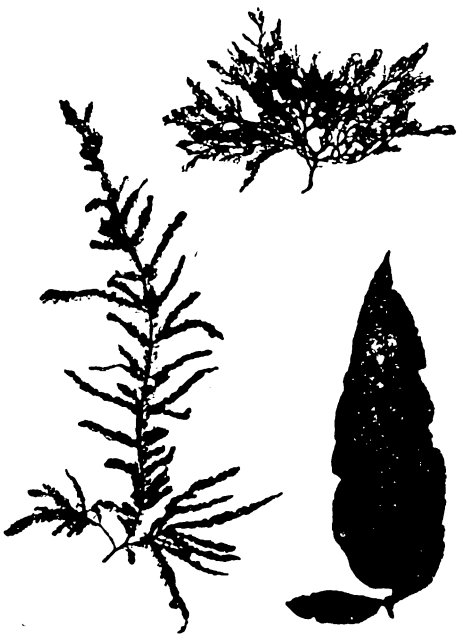
Mounting Seaweeds on Cardboard for a Collection

MAKING a collection of seaweed may be a difficult task for the average person as the regions where the different varieties may be found are limited. For



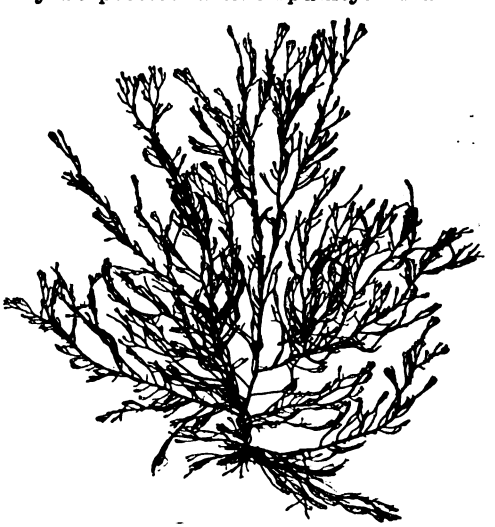
Three types of seaweeds. On the left, Dasya elegans (Jung); on the right, top, Plocamium coccineum; below, Grinnella Americana

this reason such a collection is valued and much sought after by the naturalist.

Algae (the general name for seaweed) develop no roots with which to penetrate the sand and are therefore not adapted for sandy beaches or shallow places where small stones are continually being rolled about by the tides. The ideal place for them is where the shore suddenly slants to deeper water and where cliffs and crags are scattered over the white and sandy bottoms. Here the boulders will be covered with a thick, dense overgrowth. The time to gather the plants is after flood tide, when the waves have torn them from their moorings and washed them ashore.

If some of the plants should shrink while being carried from the beach to the home, they can be easily revived by being placed in a basin of water. Placing the plants in fresh water before preparing them for mounting also draws out the salt, which otherwise would crystallize after preparation. Usually plants which have been collected are cleaned of dirt on the spot by washing. After this they are placed in a shallow basin containing fresh water. A thick piece of paper or cardboard is placed in the dish, while the plant to be prepared is placed on top of it so that it just floats above the paper. One must be careful not to use the same water for all algae or to leave the specimens too long in the bath, for some red varieties lose their brilliant color in fresh water. The delicately red-tinged kinds should be prepared on the cardboard under salt water. To prepare seaweed for mounting the plant is placed in a shallow dish containing water, a piece of cardboard is slipped beneath it and the whole plant is then carefully spread out either with a long pin or thin pincers so that it shall assume a natural appearance. To spread the thin threadlike forms a delicate touch is essential. When the plants have been spread, the cardboard is cautiously withdrawn from the water with the algae clinging to it, care being taken not to disarrange it. As a rule some parts of the plant must be rearranged after it has been withdrawn from the water. In this case, that part which is to be retouched is first wet with a brush and then placed in the desired position with the pin.

Only the thicker and tougher plants may be pressed with impunity. Place a



This delicately branched alga, Ceramium rubrum, with rich, red tints is very ornate

number of layers of newspaper over them. The first pressing should be moderate and

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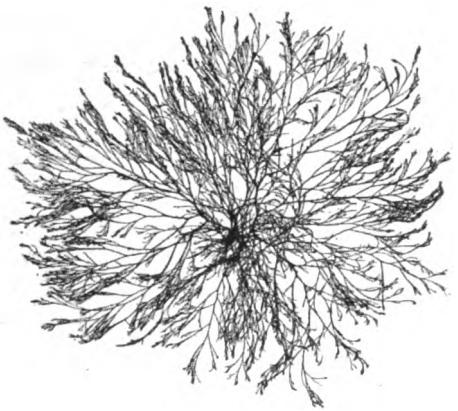
only for a short time, then the paper should be taken off and fresh layers used.

If they are pressed for long periods at a time they will stick to the paper covering, but if the pressing is gradual with

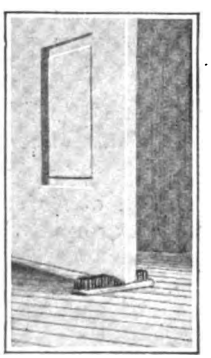


Evermore beautiful is this deeply colored seaweed, Polysiphonia variegata, with its numerous branches and delicate leaves

frequent changes of the newspapers, the algae will stick to the cardboard. Those which do not stick to the cardboard may be glued to it with the white of an egg.

That Old Clothes Brush—Use It for a Door Check

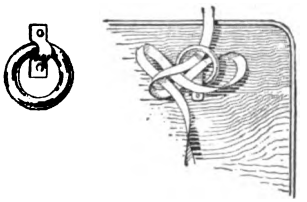
A CERTAIN door in our house would not stay where it was set, and as it was a nuisance to prop it all the time, and not wanting to purchase a door stop, one was devised as shown in the illustration. A clothes brush that was somewhat worn was placed under the edge of the door, and when the door was moved the brush would slide along on the floor and hold it there in the desired position. There is just enough spring to the remaining stubs of the brush to hold it in position, yet not enough pressure is exerted to keep the brush from sliding on the floor. Usually every household can draft such a brush to do this duty.—KARL CHASE.



Old brush under door edge

A Dash Fastener for the Driving Reins

AN iron harness ring about 2 in. in diameter is sewed, riveted or nailed inside the dashboard of a buggy or wagon for a reinholder. This will be found a convenient and safe way to fasten the reins with a simple hitch which can be quickly freed by one jerk. It is not unsightly or in the way when not in use.—A. S. THOMAS.



A ring attached to dash to hold reins

Pointers on the Care of Tools to Prevent Rust

ALL experimenters should know how to take care of tools for laying away in the tool chest to prevent rust. A tool may appear to be in first class condition but a little carelessness will reduce its lasting qualities and prevent it giving good service. Caoutchouc oil has proven itself invaluable in preventing rust. It is spread on the tool with a piece of woolen cloth in a very thin layer and allowed to dry. This coating will give protection from the weather and will not show any cracks even after standing a year. If it is desired to remove the coat just treat it again with the caoutchouc oil and after a day rub it off.

The wood parts of tools, such as stocks of planes and handles of chisels, etc., can be French polished, which gives them a fine appearance, but polishing does not make them retain their durability. It is best to soak them in linseed oil for a week and then rub them thoroughly with a cloth each day for two or more weeks. This produces a beautiful surface and at the same time acts as a preservative.

Articles of steel can be preserved from rust by placing a lump of freshly burnt lime in the box where they are kept. If this treatment is given to tools that are used quite frequently place the lime in a muslin bag. The lime will last well if the place is quite free from damp. Tools that are used almost constantly can be

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kept from rust by placing them in a box over night that is filled with pulverized slaked lime. Before using a tool rub it well with a woolen cloth.

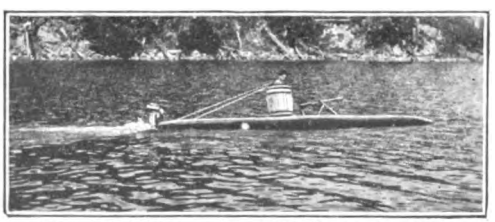
Rust may be removed as follows: Cover the metal with sweet oil and rub it well. Then let it stand for forty-eight hours. Smear the tool with oil, applying it freely with a piece of cotton wool or a feather. Rub well with unslaked lime, which has been reduced to a fine powder, and then immerse it in a strong solution of potassium cyanide with proportions of ½ oz. to a wine glass of water, allowing it to remain until the rust loosens and comes off. Remove the tool and clean it with a tooth brush, using a paste composed of potassium cyanide, castile soap, whiting and water, mixed into a paste of about the consistency of thick cream. Potassium cyanide is extremely poisonous and should be handled with great care so as not to allow any of it to enter a cut in the flesh.—E. STANDIFORD.

Applying a Coat to Ivory to Make It Look Like Silver

IMMERSE the ivory in a dilute solution of silver nitrate after having thoroughly cleaned it. Then put it into a solution of common salt until it assumes a deep yellow color. Dip it in water, and expose it to the sun's rays until it becomes black. On rubbing, the black surface will soon change to a brilliant silver.

Making a Submarine Decoy of an Old Cedar Log

THE "submarine" here illustrated was made of a flat cedar log about 25 ft. long by 3 ft. wide. One end was cut off



The submarine going at full speed across the bay in a drive at an imaginary enemy

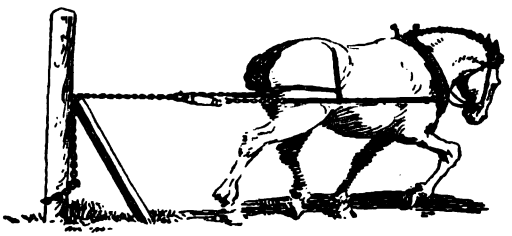
square and a piece of 12-in. plank nailed upright to it and to this plank was attached a rowboat motor. Steering was accomplished by running two ropes from the engine to the "conning tower." The "U-23," as she was dubbed, made the

A small detachable motor drives the submarine. A gun is mounted in front of a barrel serving as a conning tower

rather surprising speed of four miles per hour, and caused quite a sensation as she sailed along the bay.—R. T. PENDRAN.

Let Old Dobbin Pull Up the Old Fence Posts

THIS is a very simple post puller. It consists of a 2 x 6-in. timber about 3 ft. long, placed in a slanting position against the post which you desire



With a piece of plank, a chain and a horse, fence posts are easily pulled out

to pull out of the ground. Fasten the chain around the post just above the ground and run it over the plank. The next step is to hitch a singletree to the end of the chain and one horse easily pulls out any ordinary fence post. This device will be found very handy by farmers repairing their fences or tearing out old ones to replace them by the modern steel or concrete fence posts which have won such great favor among farmers generally. The chain may be quickly attached to any post and the prop put in place. The parts are easily carried to the next post to be drawn.

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A Handy Substitute for a Paint Striping Brush

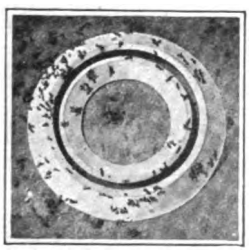
THE amateur will usually find that striping his remodeled speedster is a difficult job, especially with such brushes as he happens to have on hand. An excellent method of producing neat stripes is to use the striping paint in a draftsman's ruling-pen, using a yard-stick to steady the hand or guide the pen.

Catching Ants in Pie Tins—How It's Done

IN the western states there is a large red ant whose bite is very painful and lasting in its effect. When a nest of these ants becomes established it can only be eradicated by persistent and continued application of a strong poison in the form of powder sprinkled around the hole. No amount of water will drown them out. As the poison method is slow and somewhat dangerous, the writer devised a trap which is very effective, and if kept in place long enough will eliminate the whole tribe.

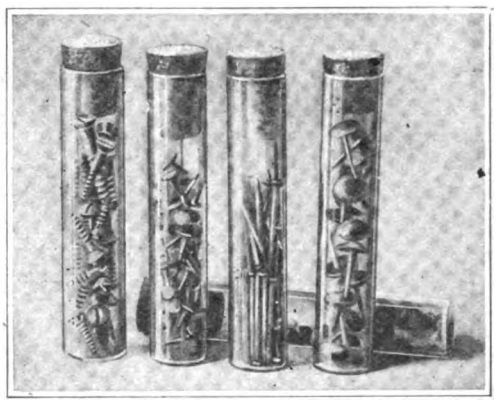
Cross section of pie tins over the ant holes to trap ants

The base consists of an annular disk of tin about 8 or 9 in. in diameter. On this are mounted two rings made by cutting out the bottoms of two pie plates, one large and one small. When the three parts are assembled the result is a circular track with two sloping walls, separated by a space 3/8 in. wide at top. The outer walls should be coated with paint so that the ants can easily run up. The trap is then placed over the nest with the hole in the center. Now, ants are always either coming or going, so that in the course of a few minutes almost every ant must run either up the outer or inner wall. This they do with great speed, as the entire nest becomes excited. The result is that they tumble in by the hundreds, and are unable to escape, as they cannot climb up the shiny interior surface when they are upside down. In the hot sun the inside of the trap becomes very warm. The heat soon kills the ants.—JOHN D. ADAMS.


Top view showing ants being trapped

Convenient Method of Keeping Brads and Screws

HOW do you assort and preserve all the various kinds of brads, screws, tacks and rivets required in a well-ordered household? See if this method doesn't appeal to you. Procure a number of wide-mouthed "homeopathy" vials, with corks, and keep them filled with these little articles. They require no labels since the contents are always visible and they are protected from dust and rust. The little bottles containing photographic developer can be had from any amateur photographer and are just the thing after the wrappers are removed with warm water.—W. H. SARGENT.


Small vials inclosing screws, tacks, nails and the like, in which they may be easily seen

Saving Undersize Bushings and Liners by Plating

EXPENSIVE brass and bronze bushings are often thrown out of production and consigned to the scrap pile at inspection benches on account of being turned undersize. These may be saved by building up the diameter with copper plating, the expense of so doing usually being slight in comparison with the value of the article.

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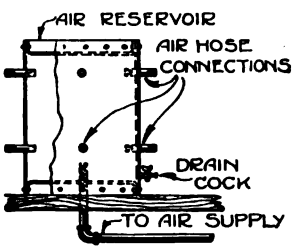
Silver Plating That Will Not Scale When Burnished

WHEN silver-plating steel or brass articles, much annoyance is caused by the scaling off of the silver during the burnishing process. This may be very easily avoided by immersing the article for a few minutes in a hot solution of potash or soda, and rinsing it without handling in water. It should then be dipped in dilute nitric acid, removed and scoured with a stiff brush or fine sand if necessary. Attach the wire, dip it again momentarily in the acid, pass it rapidly through clean water and immediately place it in the circuit in the bath.

Compressed Air Manifold for Boiler Shops

IN boiler shops where a large number of pneumatic tools are constantly in service it is quite impossible at times to make a connection with the air main without using several lengths of hose. Again, where there are several leads or connections branching from a drop line, part of the efficiency of the tool is lost due to the pipe not being able to supply air at the proper working pressure fast enough.

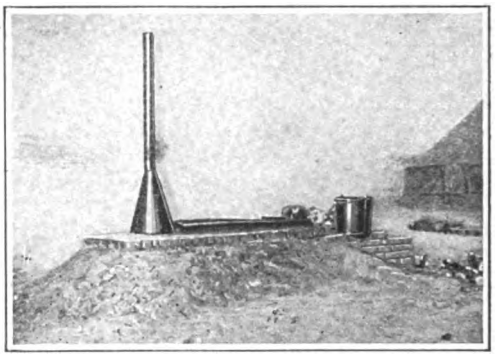


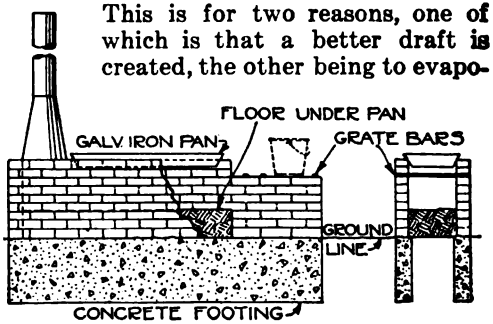
One of the storage air drums for shop use

In order to eliminate trouble several compressed air drums about 14 in. in diameter and 20 in. long were placed in various parts of one shop, fitted up as shown. Several pipe nipples are placed in the drum. Stop cocks were placed on the nipples, into which another nipple is screwed and a hose connection placed thereon. A drain cock is placed at the bottom of each drum to drain off any water which may accumulate. Several lines can be attached to the drum without loss of efficiency as the capacity is large enough to maintain an equal pressure. This arrangement also effects a saving in pipe lines and maintenance as well as the volume of compressed air necessary to fill the pipe lines.—J. R. MINTER.

Burning the Camp Garbage—How the Army Does It

AS a part of the sanitary system adopted by the Government for the guardsmen on the Mexican border last season, a garbage incinerator was devised which has proved quite efficient. The details are fully given in the illustrations. The wood fire is built in the opening under the pan, and into the latter all liquids are thrown and boiled down, the resulting residue being raked out and thrown into the fire. All solid matter, such as parings, etc., are thrown directly into the fire and burned. The grate bars over the open end of the incinerator are used to hold pails of water which are heated to wash the guardsmen's mess kits. It will be seen in the illustration that the bottom of the fire-box is about 1 ft. higher under the pan than it is under the grate bars. This is for two reasons, one of which is that a better draft is created, the other being to evaporate the liquid remaining in the garbage more quickly. This incinerator may be built with a brick chimney instead of the sheet-iron pipe.—GEORGE M. PETERSEN.


The top of the garbage incinerator as it was built for camp use by the American soldiers



Plan of the incinerator showing method of construction with concrete base

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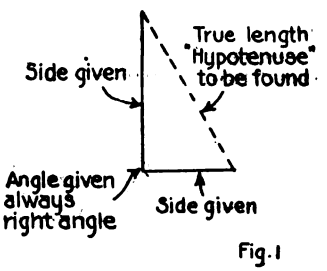
Simple Designs for Sheet Metal Working

XV.—Development of patterns for sheet metal work by triangulation

By Arthur F. Payne
Director of Vocational Education, Johnstown, Pa.

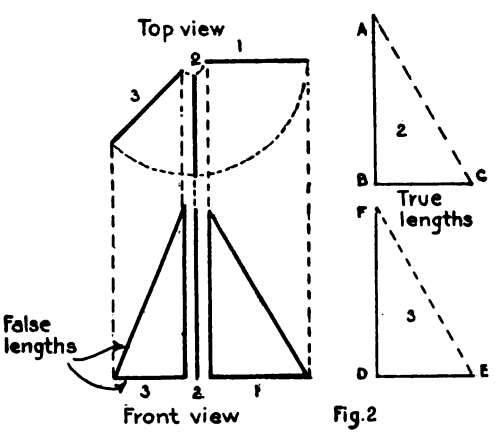
THE development of patterns by triangulation is a subject of great interest to sheet metal workers. Many arguments and discussions have been held concerning the manner of developing patterns for certain pieces. Many workers claim to possess the "secret" of triangulation, and decline to divulge it. Others have the ability to develop certain patterns but not others. All of this misunderstanding and acrimonious debate will be cleared away if we get an understanding of the following three points: First, most of the difficulty in learning triangulation is caused by the fact that most of the workers want to start right in on triangulation before they have mastered the preliminary work leading up to it; therefore, all new readers are advised to work out all the problems in the previous issues. Second, there are three different ways of developing any pattern by triangulation, and securing the "true lengths" and all three of these ways are right. Some workers use one way and some another, but all three are based upon the same principle. Third, many students of triangulation fail to get a thorough understanding of the fundamental principle upon which triangulation is based. Like many other essentials, this principle is difficult to explain and somewhat difficult to grasp, but very simple and enlightening when mastered.



The problem of finding the hypotenuse with two sides given

The illustrations (Figs. 1 and 2) show this principle which is merely one of the simplest problems of plane geometry and is stated thus: "Given two sides of a triangle and an angle, construct the triangle." In our case this problem is very much simplified by the fact that the angle given is always a right angle and the side we have to find is always the long side of the triangle called the "hypotenuse." This is illustrated in Fig. 1. In every pattern developed by triangulation we are always trying to find the "true length," which is always the "hypotenuse" of the triangle. We will obtain from the front and top view the two "given sides." The angle is always a "right angle" which is an angle of ninety degrees, commonly called a square corner, and the hypotenuse is the "true length," we have to find.

The problem of finding "true lengths" is shown in Fig. 2. The front view (1) is a drawing of an ordinary 30-60 draftsman's triangle and (1) top view is the top view of the same triangle. Now it is very easy to see that we already have the three sides of this triangle; therefore, no problem is presented. However, if we swing the triangle around until its edge is facing us, as in 2, we have a problem in triangulation. We are given one side in the front view which we will draw as A-B of 2 of the "true lengths." Another side is given to us in the top view. This



Finding the true length of the hypotenuse when lengths of the other two sides are known

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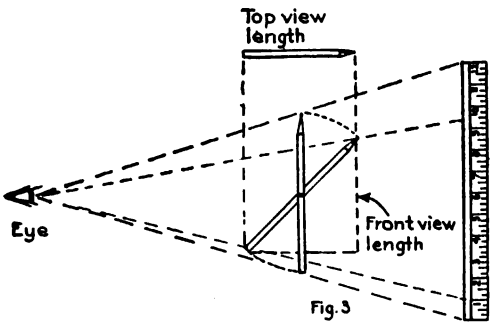
we will draw as B-C and the line we wish to obtain is readily drawn as the dotted line A-C. Now look at front view (3). Two lines are false lengths because they are "foreshortened" or pointing towards us, as shown by the top view. The top view line is a "true length" line drawn as



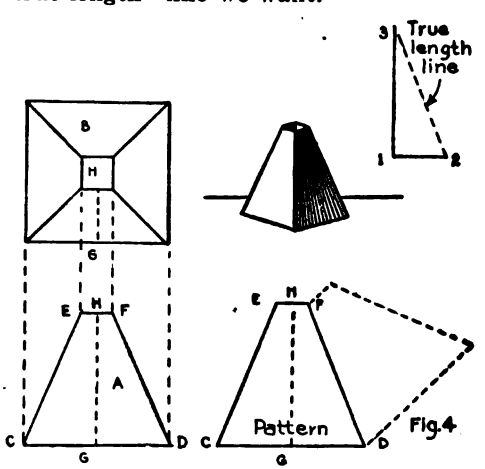
Illustrating the method of foreshortening with pencil and a one foot rule set upright

D-E of the "true lengths;" draw the front view "true length" line as D-F then draw the dotted "true length" line F-E.

The illustration (Fig. 3) is another interesting method of demonstrating the same principle. Place a 1-ft. rule upright on a table, hold your pencil at arm's length, move away from or towards the rule until the ends of the pencil and the rule coincide as shown; then, holding the pencil in the middle, turn the point towards the rule. Measured by the rule it will become apparently shorter. This is what we call "foreshortening." At an angle of forty-five degrees it will measure only 8½ in. The top view length is false because the butt is receding from us; the front view length is false because the point is receding from us; but if we arrange the top and front view lengths to form a right angle, as shown by the dotted lines, the pencil will be the "hypotenuse" or "true length" of the pencil which is what we are after.

The illustration (Fig. 4) is a very simple practical problem that illustrates the practical use of the theories advanced. The piece illustrated could be used for a square pipe reducer; upside down it could be a hopper. Its geometrical name is "truncated pyramid." The steps taken to develop the pattern by triangulation are: First, draw the front view, *A*, and top view, *B*. As the four sides are exactly alike it will only be necessary to develop one side, that shown in the front view, *A*. Notice that the lines, *C-D* and *E-F*, are shown in their "true length," but that the lines, *C-E* and *D-F*, are "foreshortened"; the top is leaning away from us. If we can get the "true length" of the dotted line, *G-H*, that will give us the height of the center of the pattern, and as we already have the "true length" of the top and bottom, we will only need to connect the top and bottom with the slanting side lines to complete the pattern.

To get the "true length" of center line, *G-H*, set the length, *G-H*, of the top view off as 1-2 of the "true length" triangle. Then set the length, *G-H*, of the front view off as 1-3 of the "true length" triangle. The dotted line, 2-3, will be the "true length" of the center line, *G-H*. Right here you have an excellent opportunity to grasp the fundamental principle of triangulation. Notice that we are treating the lines, *G-H*, of the front and top views the same as we did in 2 of Fig. 2, that is, as the top and edge view of a triangle; and having two sides of a triangle and the right angle it is very easy to draw the third side which is the "true length" line we want.



Developing a pattern for a truncated pyramid using the triangulation method given

Now set off the line, 3-2, as *G-H*, of the pattern, draw the top line, *E-F*, and the bottom line, *C-D*. Connect with the slanting lines, *C-E*, and *D-F*, and the pattern for one side, is complete. It is only necessary to complete the pattern four times as shown by the dotted pat-

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tern and the pattern for the "truncated pyramid" will be complete.

The illustration (Fig. 5) shows the method of developing the pattern for a "compound offset." This is used in furnace piping that runs up inside the partition of a room. If the partition of the second floor runs at right angles to the partition on the first floor the rectangular furnace pipe must be changed so that it will fit into the partition. This compound offset is placed between the floors, over the first floor partition and under the second floor partition.

Notice that all four sides are exactly alike, although it may be difficult to see this at first. After studying this problem you will find that it is worked out in exactly the same way as problem Fig. 4. First, draw the front view, *A*, and the top view, *B*. Notice that the lines, *E-F* and *C-D*, are, "true length" lines. If we can get the "true length" of the dotted lines, *G-H*, we can easily lay out the entire pattern. Set off the length, *G-H*, of the top view as line 1-2 on the "true length" triangle. Set off length *G-H* of the front view as line 1-3 of the triangle. Draw the dotted line, 3-2, which is the "true length" of line *G-H*. Set this line off as *G-H* of the pattern. Draw lines *E-F* and *C-D*. Draw the slanting side lines, and the pattern for one side is complete. Reverse the pattern for the other three sides and the pattern for the compound offset for furnace pipe is complete. Allowance must of course be made for the flange at the top and bottom and for the seams.

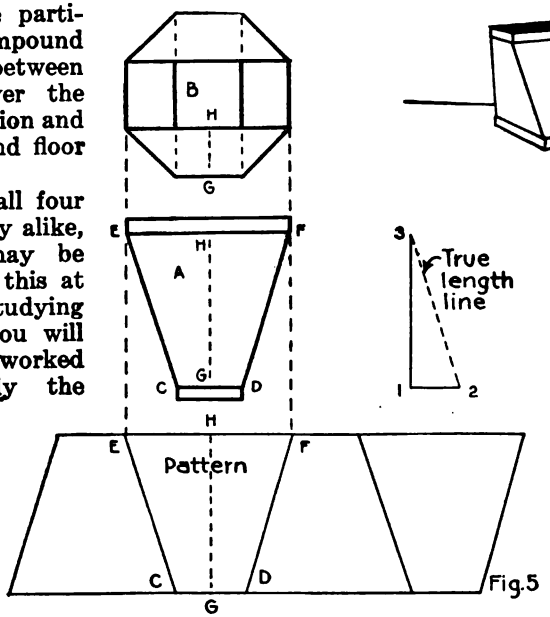

Fig. 5

Using the triangulation method for developing a pattern for a compound offset in furnace pipes

The illustration (Fig. 6) shows a real problem in triangulation. The problem chosen is a rectangular register box with a round inlet but the method used to develop the pattern would do equally well for a square to round, or rectangular to round, pipe fitting, or it would do equally well for a hopper leading into a round pipe.

The small sketches on the left show other forms of register boxes. The one on the right is a sketch of the register box we are to develop the pattern for. The view marked *A* is the front view, the one marked *B* is the top view; these must be drawn first. If we study these two views we will see that the pattern cannot be developed by the "parallel line" method or the "radial line" method, so we shall use the "triangulation" method. But the reader may ask "How do we know that the pattern can be developed by the triangulation method, or even developed at all?" The author of this series has had many interesting discussions with the sheet metal pattern drafters and has had submitted to him many problems said to be impossible of development. To settle this point let us remember that if the subject is straight in one direction on its entire surface, it can be developed. By this I mean that if we place the edge of a rule on the problem and it touches along the entire edge and we can cover the entire surface by moving the rule, we can develop the pattern. If we should place a short rule vertically on this register box and move it around, we could cover the entire surface. We should also find that on the four sides there would be large triangles that would be flat. The triangles have been outlined in pencil because they are an important part of the development. They are marked *C-D-E-F* on the top view and on the pattern. On these triangles the rule would lie flat in any direction. In the corners we should find

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a place that is straight one way and curved another. To develop this surface we break it up into a number of small triangles.

After we have drawn the front view, *A*, and the top view, *B*, we next lay out the large triangles, *C-D-E-F*. The next step is to get the pattern of the large triangle, *C*. Notice that the side, *G-H*, is in its true length so we can project that down and start our pattern with that line. Now we have to get the length of the sides of the triangle, *C*. This is done by triangulation in the following manner: We must consider that the line, 5-*H*, in the top view is the top view of the triangle, 5-*H*-*K*, in the front view. The line, *H*-*K*, is a "true length" so we project that over to the right. Then we take the distance, 5-*H*, from the top view and set it off as *K*-5 on the "true length" triangle, and the dotted line, 5-*H*, will give us the "true length" of the side of the triangle, *C*. Set off this line on the pattern, both sides of this triangle are alike, so make the side, 5-*G*, the same as 5-*H*.

Now divide the one quarter of the circle on the top view into four equal parts. Number them as indicated and draw lines from these numbered points to the corner, *H*. If we can now get the "true lengths" of these lines we can lay out our pattern, because we know the correct distance between them is shown by the numbered points on the quarter circle.

So we have to get the "true length" of the line, 4-*H*. Think of 4-*H* on the top view as the top view of the triangle, 4-*H*-*K*; the line *H*-*K* is a "true length." Project it over to the right. Set off 4-*H* of the top view as *K*-4 on the "true length" triangle and the dotted line, 4-*H*, will be the "true length" of 4-*H*. Now take the distance, 5-4, of the top circle and set it off as 5-4 on the pattern circle by striking a short arc. Then take the "true length" line, 4-*H*, and set it off as 4-*H* on the pattern. Repeat exactly the same process for lines 3-*H*, 2-*H*, 1-*H* and connect the points with a free hand curve.

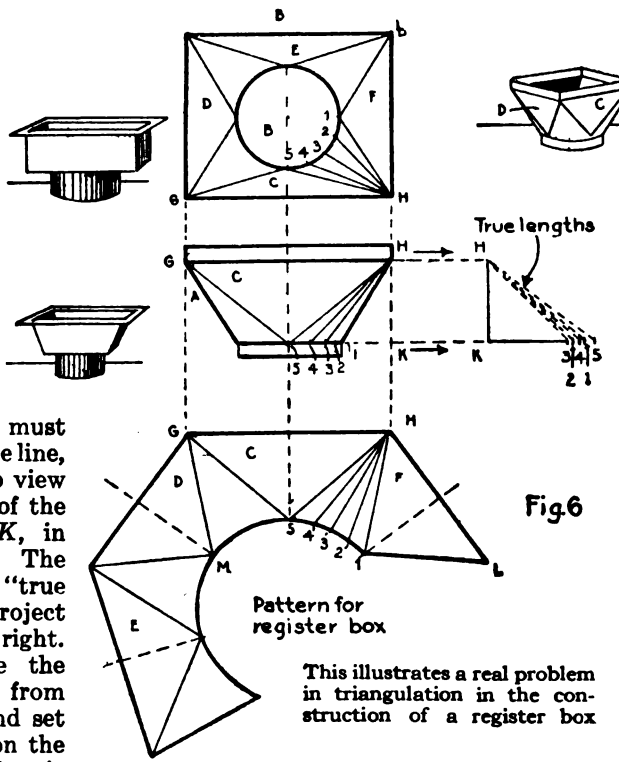

Fig.6

This illustrates a real problem in triangulation in the construction of a register box

Then take the distance, *H*-*L*, of the top view and strike an arc from *H* to *L* on the pattern. Take the distance, 1-*H*, and set off as 1-*L* and the pattern for the end triangle, *F*, is complete.

Now we need not develop any more of the pattern, because the four corners are all alike and the triangles, *C*, *E*, and *D*, *F*, are alike. So lay out the triangle, 5-*G*-*M*, the same as 5-*H*-1. This gives us one-half of the pattern. Then slip the pattern along to the left until the line, 1-*L*, matches the line, *M*-*G*, and the whole pattern is complete.

The students of this series are cautioned not to expect to grasp these problems without studying them carefully, and working out every one conscientiously. If any difficulty is experienced with this register box pattern, read the entire article over again. It is very important to grasp the principle of triangulation thoroughly at this time because the successful solution of the problems planned for the future will depend upon a thorough grasp of this underlying principle.

(*To be continued*)

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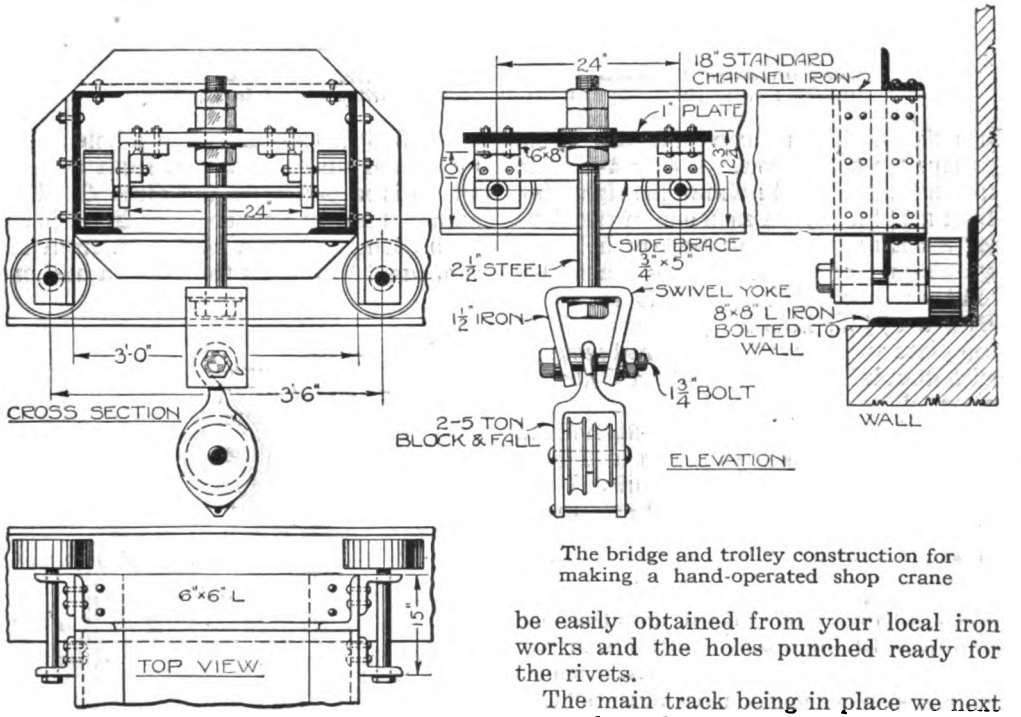
How to Make a Hand-Operated Crane for the Shop

THE crane shown in the illustration is easily and cheaply constructed in your own shop and is suitable for wood as well as brick structures. The idea is to provide a means of transporting, lifting or carrying any heavy casting, piece of machinery, automobile motors, transmissions, axles, boxes and heavy parts to be shipped, to remove a heavy forging from the lathe to the planer or drill press and numerous other lifting jobs. Use standard 18-in. channel iron for the cross bridge and extra heavy 8-in. by 8-in. angle iron for the side wall or main track. The angle irons run the longitudinal length of the building while the channel iron runs the cross length and are cut to fit in between the angle irons, allowing sufficient clearance so that the rollers will not jam against the sides.

The angle irons should be drilled and countersunk every 24 in. with a ⅞-in. drill. They are bolted to the wall as shown. If the wall is brick set a pilaster of brick 12 in. square under the angle iron to hold it up. Make the pilaster of good brick and best cement mortar with a 12-in. footing below the floor line. If it is a frame structure use a 10-in. I-beam with its base set in a concrete footing made up as follows: 1 part cement, 2 parts sand and 4 parts coarse gravel, all to be well mixed and the columns set in at once and braced up straight. These are allowed to stand until the concrete has completely hardened before the other work is continued. Connect the columns to the angle iron track with ½-in. corner plates 6 in. by 6 in. and riveted with 8 ¾-in. rivets in each one. The iron may be easily obtained from your local iron works and the holes punched ready for the rivets.



The bridge and trolley construction for making a hand-operated shop crane

The main track being in place we next proceed to the construction of the cross movable bridge and the traveling block carrier. The bridge is made from two lengths of 16 or 18-in. channel iron, bolted or riveted together by heavy 6 in. by 6 in. angle irons at each end, top and bottom. On both sides at each end are two pieces of 5 in. by 5 in. angle irons riveted in place and a hole drilled through both pieces for a 1½-in. bolt, which is used for an axle.

Build the carriage frame as shown, 24 in. square with a top plate 24 by 30 in., to which are riveted four 6 in. by 8 in. angles, and two cross braces ¾ by 5 in. Drill holes on the lower ends of the bottom

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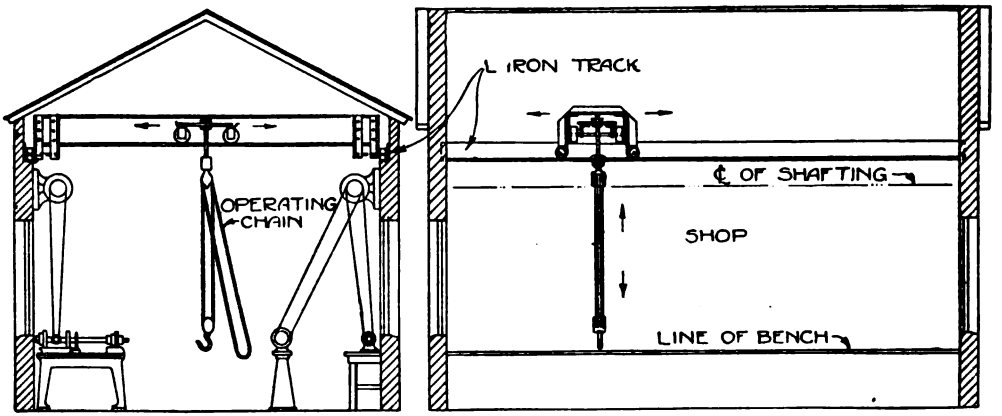

Cross and longitudinal sections of a building showing how the tracks are placed to carry the bridge and trolley runway when placed in the shop

legs for a 1½-in. axle and use 10-in. pulleys for the wheels. A 3 or 4-in. face to the pulleys will be about the right size. Drill a ¼-in. hole in each end of the shaft for a cotter or a small bolt to hold the wheels in place. A washer is placed behind each wheel to make it run free. Drill a 2½-in. hole in the center of the top plate and fasten a 2½-in. rod securely with double lock nuts. Make a U-shaped piece of band iron and drill a 2½-in. hole in the center and two 1¾-in. holes in the legs, through which run a 1¾-in. bolt for hanging the pulley block. Use a good standard steel block and chain with safety stop and large hook of forged steel at the bottom.

The universal action of this homemade crane makes it an almost indispensable accessory in all mills, repair shops and garages, and especially machine shops, as it can cover every part of its area of travel. It will carry several thousand pounds easily and can be pushed from place to place by one man.—P. P. AVERY.

Stanchion for Holding a Hog Fast While Ringing His Nose

THE hog holder illustrated may be made of 1¼-in. oak or pine. The frame is made first from two pieces *A* 3 ft. long, two pieces *B* 38 in. long and two pieces *C* 31 in. long. A hole is bored in one end of the pieces *B*, which are then securely fastened together. Cut a piece *D* 45 in. long and bore a hole in each end and bolt it to the cross piece *C*. Cut a piece *E* 3 ft. long and bore a hole in the lower end and one 10 in. from the top where it is bolted to the piece *C*. This makes it ready for the lever F, which is 30 in. long. Bore a hole 9 in. from the top, one 10 in. from the bottom and one

Details of a stanchion which is placed in front of a hog house door for catching and holding a hog while ringing his nose

in the bottom of the lever and bolt it to the end of *B* as shown, then make a piece *G* 30 in. long and 2½ in. wide and bore a hole in each end and bolt it to the top of the pieces *D* and *F*.

Make a connecting piece 20 in. long and 2½ in. wide; then bore a hole in each end and bolt it to the pieces *E* and *F*. Cut six notches in the piece *B* 1 in. deep

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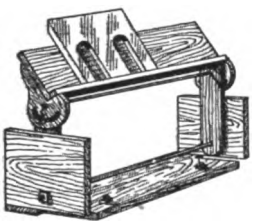
and let the right side slant towards the lever. Make the piece *I* 10 in. long and 1 in. square, bore a hole in the end of it and bolt it to the lever as shown. Fasten the hog-holder in the hog-house door when you are ready to ring his nose and the work can be done easily by one person.—H. V. STANLEY.

An Ingenious Grinding Rig for Steel Knives

A GRINDING rig as shown in the illustration will be found a welcome addition to any woodworking establishment or wherever a large number of knives need to be ground.



Knife holder to grind edge at proper angle

It is especially quick and handy for thin steel knives, for, no matter how short they are, it is difficult to hold them by hand to a uniform level. It is instantly adjustable to any level, or width of knife, using a small or large grinding wheel. With it knives can be ground perfectly straight without any trouble or loss of time.—J. C. GRINDELL.

A Coating for Drawings to Preserve the Lines

WASH the drawing well with a solution of isinglass. Prepare another solution by dissolving 1 oz. of Canada balsam in 2 oz. of best oil of turpentine. Coat the drawing with this, using a camel's hair brush to obtain an even surface.

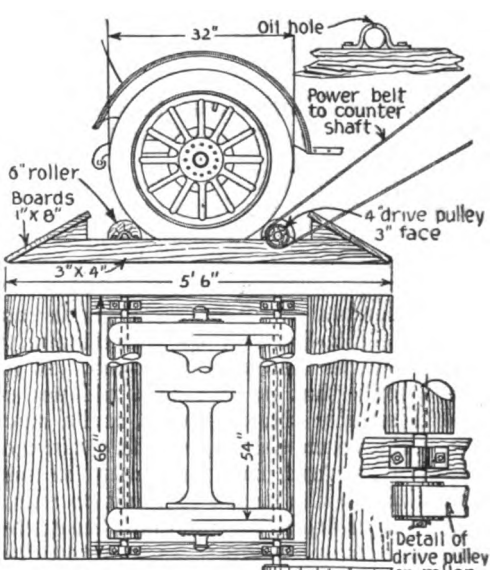
Photographic Plates Used for Mounting Pictures

FOR mounting post-card photos an excellent and unique mount, I have found, can be made easily and conveniently by taking an old post-card plate and removing the emulsion by pouring hot water on it and scraping off with a sharp knife. The plate is then dried, placed over the face of the post-card photo, and both are bound together along the edges with lantern-slide binder or adhesive tape.—H. K. CAPPS.

An Automobile Engine Used for Driving Stationary Machinery

THE automobile appears to be the first power-propelled piece of machinery a farmer will purchase and its power plant is useless when not employed for its intended purpose. Many devices are manufactured for utilizing the engine power for driving stationary farm machinery, but the handy man in his leisure hours can construct such a device that will answer the purpose just as well. The illustration shows one of these devices.

Make a frame of 3 by 4-in. hemlock timber with crosspieces of 2 by 4-in. pine. Procure two rollers 6 in. in diameter and as the tread of the automobile. These may be turned up at a local wood or metal working shop and the ends of the shaft fitted in bearings nailed or bolted to the timbers. Attach a pulley on the end of one of the shafts. The ends of the timbers are sloped and boards are nailed on them so that the automobile can be run up and on the rollers, as shown. Block the front wheels in front and behind, then with the gears thrown in high, a most efficient power plant is obtained. This device does not cost much to make and it will do the work in



Platform with roller on which to drive an automobile for using it as a power plant

place of a small stationary engine or electric motor.—P. P. AVERY.

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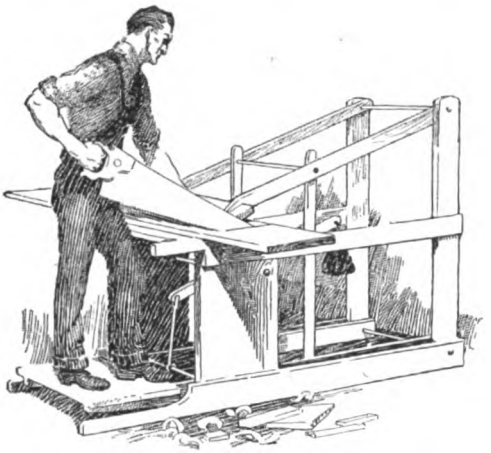
A New Type of Carpenter's Saw-Horse

WHILE this saw-horse may appear to be cumbersome in use the operator will find it a great convenience. The upper swinging arm or jaw is operated through connecting arms by the foot treadle. A



An elaborate saw-horse for holding boards of various widths and different thicknesses

counterbalance weight is attached to open the jaw when placing a board in or taking it out. The operator stands on the treadle which clamps the boards on edge for sawing.—A. S. THOMAS.

Kinds of Hand-Saws to Use on Hard and Soft Wood

WOOD-WORKERS, generally, in choosing a saw for a given job, will estimate the efficiency of the saw by the appearance of the work after the cut is made. This can be the cause of very serious errors in fine work, such as cabinets, ship-joinery, etc., particularly where several men are employed. It is well known that no two men will use a tool in exactly the same way, and a saw that will produce a clean, smooth cut in the hands of one man may make a cut far less true when in the hands of another man.

Setting aside, for the moment, the questions of sharpness and set, the determining factors will be those produced by the human element; that is, the speed of the saw, the manner in which it is held, the pressure against the wood being cut, and the length of stroke; this latter consideration being a joint consideration with the speed. Naturally, a man sawing adapts himself to the most easy and comfortable position, and also to the most convenient length of stroke, which is governed by his reach, or length of arm. The man having the greater arm length makes the best sawyer, generally speaking, simply because, while making the same number of strokes per minute as the shorter armed man, the length of the saw stroke, and consequently the speed at which the saw teeth pass over the work, is greater, and the right speed for the saw more nearly approached.

The cutting speed for wood is so high as to be unobtainable by any hand tool, but, as the workman approaches this speed, an improvement in the quality and quantity of the work becomes more and more apparent, and the softer the wood, the more important the speed factor becomes. This will account, to an extent, for some of the vagaries observed in sawed work, when the saw is known to be correct as to sharpness and set.

Consider, now, a piece of hard wood, say 2 in. thick. We know that the speed at which this material should be cut cannot be obtained by hand through rapid movement of the saw; but there we have an opportunity to interpose an offsetting condition by increasing the number of saw points which shall pass over the work in a given time. It is plain that if we use a five-point rip-saw, operated at a speed of "n" feet per minute, the number of cutting points passing through the wood in one minute will be 5n, and will remove a certain amount of wood. Now, if we increase the number of cutting points to 6, we can remove a greater amount of wood per minute.

It must be remembered that only a certain amount of wood can be removed in a given time; therefore, the depth of cut that can be produced in a stated time is in proportion to the width of the cut, and if a saw has too much set, even a slight amount in excess of that required, the width of the cut is increased and the depth of the cut is diminished, decreasing the efficiency of the saw, and making for slower and poorer work.

For this reason, the set of a saw should be as light as possible, and must be determined by the grade of wood being cut.

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In rip-saws, the teeth per inch are 5, 5½, and 3. Finer points are not used because of "choking" due to the softer, spongy matter occurring between the "year growths" of the wood, caused by the diminished supply of cell-forming sap during the winter months when the tree was growing. This spongy matter varies, also, with the quality of the wood. In a rip-saw, then, for hard wood, we recommend a saw 28 in. long, having 5½ or 6 teeth-points per inch.

The quality of the work will be improved, and the saw will "hold up" longer if, after filing, the teeth are oil-stoned with a knife-edge oil-stone, passed over the teeth in the same manner as the file. For very thin wood a finer toothed saw is necessary, and especially so if the wood is soft, because the softer the wood, the softer is the spongy substance between the growths of the wood. In soft wood the saw teeth cut in more readily. The point is, then, to provide a saw that will have enough teeth in constant contact with the wood to prevent the teeth from "digging in" and so tearing.

In thick wood, several teeth are always in contact with the wood, even though the saw be of a coarse pitch. The net result of this is to form a bearing, so to speak, which permits each tooth coming into contact with the wood to enter straight and steady. On the other hand, if we use a coarse saw for thin wood, the one or two teeth resting on wood in the saw-cut, do not give a firm bearing. Each tooth reaches the wood in a sort of "jump," and jumps out again on the lower side, producing a series of blows, especially if the saw is at all dull; this will cause a tearing effect. For this reason it would be advisable in ripping thin wood to use a saw giving the best possible bearing continuously on the wood, say a saw having 6 points to the inch, and 26 to 28 in. long, for ripping thin wood of about ¼ in. The foregoing applies where accuracy and smoothness of cut are the first essentials.

Where quantity is the primary consideration, a coarser saw, say 4½ or 5 points to the inch may be used to advantage in the heavier wood. In hard woods, a little dullness of the saw can be tolerated, but in thin pieces, or in soft wood, the saw must be perfectly sharp, and finished with an oil stone.

A rip-saw for hard wood should be filed so the face of the teeth has a back slope of about 2 deg. and the back of the teeth should be filed to give an angle of 60 deg. with this face-angle. This produces a sturdy cutting point. In ripping soft wood, however, the face of the tooth may be concave a little; say a radius of ⅞ in. to 1 in. for a 5½ to 6-point saw, to give clearance, and to provide a more acute angle at the cutting point.

In cross-cutting, we are dealing with different problems, and have to consider an entirely different form of tooth. For this, the saw always has a greater number of points per inch than is necessary for a rip-saw; for, if we are cross-cutting hard wood, we have a harder cut than in ripping, and in cross-cutting soft wood the cut is far more wearing on the points of the teeth than is ripping. In addition to these considerations, if the saw becomes a little dull, especially in cutting soft wood, there is a tendency to pull the fibers of the wood out, rather than to cut them. Therefore, it is desirable to have a saw possessing a greater number of points to the inch in order that a larger number of these cutting points may pass over the wood in a given time. The wear is distributed over a greater area of metal in the saw, also the wood removed in cross-cutting has a better mixture of "spongy" matter and true fiber, so that there is less tendency to "choke," and the employment of a larger number of cutting points is practical.

As in a rip-saw, if a close, smooth job is the object, a fine-toothed saw must be used, say 10 points to the inch for thick or hard wood, and 12 points to the inch for soft or thin wood. I would also advise that the 12 points to the inch be used for thin pieces of hard wood, while a panel saw may well be carried for extra-thin pieces of soft wood. This arrangement is calculated to economize in saws, and at the same time to give a set of the greatest efficiency. A cross-cut saw, also, should be well sharpened with an oil stone after filing, but in a very different way from the method used for rip-saws.

The method generally used in saw filing is to file from the edge of the tooth toward the back, away from the cutting edge. A better way is to file toward the front, or toward the cutting edge of the tooth. This

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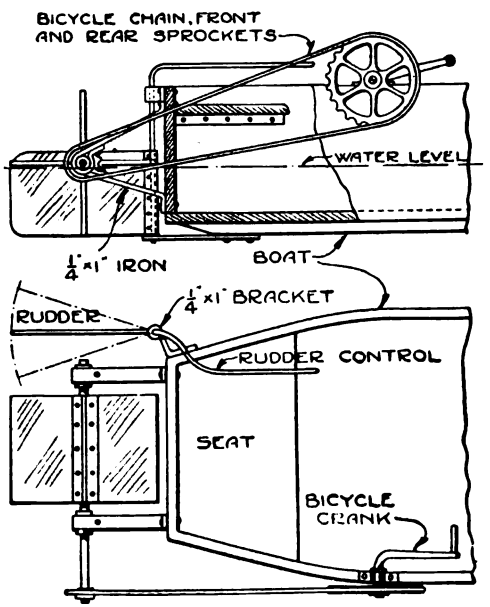
will produce a "wire edge" on the cutting edge. Now take a large, flat oil stone and place it on the side of the saw, passing it from the heel to the point of the saw, to remove the wire edge. A saw so treated will cut clean and true, for this will give a straight, sharp and true cutting edge. A saw as usually filed will show a ragged edge under the magnifying glass, and the cutting edge may even be a little rounded if the man who filed it was not very expert.—J. B. MURPHY.

A Handpower Paddle Wheel for a Rowboat

THERE are some persons who like a boat ride but do not take kindly to rowing with oars. For those having this disinclination the paddle wheel here shown was especially designed. A



Stern wheel propeller for a rowboat to drive it by turning a crank by hand

shaft supported with two brackets at the stern, and carrying a paddle wheel made of thin metal sheets into four divisions, has one end fitted with a small sprocket placed in line with a driving sprocket stationed on the gunwale just forward of the canoe seat. These sprockets, as well as the crank, may be secured from an old bicycle.

As the paddle wheel is located directly back of the boat it is necessary to change the rudder, which is shown set to one side in the illustration. Its bearing is attached to the side of the boat and the steering arm brought over near the canoeist's seat. The right hand is used to turn the crank and the left on the rudder arm. With this propeller a rowboat may be driven in shallow water as well as in midstream for the propeller blades do not extend below the keel.—P. P. AVERY.

Lumbering Dimensions for Figuring Quantity Wanted

ALL lumbermen talk in terms of board feet. A board foot is a piece of timber 12 in. long, 12 in. wide and 1 in. thick. This means that a block of timber 12 in. square on the ends and 1 ft. long would contain 12 board feet. Follow this simple rule: Multiply the end dimensions together and divide the product by 12 and then multiply by the length of the piece in feet. Thus, a 2 by 6-in. studding which is 16 ft. long contains:

$$\frac{2 \times 6}{12} \times 16 \text{ equals 16 board feet.}$$

The table which follows gives the board measure per lineal foot for the different sizes of lumber that are ordinarily used on the farm:

1 by 4 in.	.33	board ft.
1 by 6 "	.50	" "
1 by 8 "	.67	" "
1 by 10 "	.83	" "
1 by 12 "	1.00	" "
2 by 4 in.	.67	board ft.
2 by 6 "	1.00	" "
2 by 8 "	1.33	" "
2 by 10 "	1.67	" "
2 by 12 "	2.00	" "

Make Due Allowance for Lapping

In covering walls, floors, ceilings, etc., with the common lumber stock it must be understood that 100 ft. of lumber will not cover 100 ft. of the surface, such as the floor or wall. It is necessary to add to the actual measurement of the surface to be covered so as to allow for the lapping of the boards or the matching. The amount to add varies with the different

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kinds of stock as shown in the list which follows:

4 in. flooring.....	add 33	per cent.	
6 in. flooring.....	" 20	"	"
Horizontal sheathing	" 20	"	"
Diagonal sheathing.	" 25	"	"
Ship lap for walls...	" 20	"	"
Lapsiding, 4½ in...	" 33	"	"

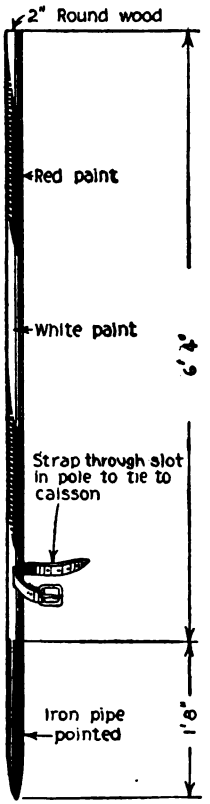
The greater portion of the southern yellow pine lumber that is marketed in the United States is graded and classified in accordance with the rules of the manufacturers' association. It is customary to figure ¼ to ⅝ in. smaller sizes than those given for this sort of dimension lumber. For instance, a rough 2 by 4-in. studding will measure when dressed or surfaced 1⅝ by 3⅝ in. A 2 by 6-in. piece will measure 1⅜ by 5⅝ in. These measurements are for timber which is surfaced on one side and one edge designated (S1S1E). This is the ordinary size of "Yard Stock" which the farmer will purchase from his dealer. In case the timber is surfaced on all four sides a 2 by 4-in. piece will measure when dressed 1½ by 3½ in. and a 2 by 6-in. piece will measure 1½ by 5½ in. This should be remembered, for a piece may be selected too small for its intended purpose.

Price of Timber Sure to Increase

The annual per capita consumption of lumber in the United States is about five hundred board feet as compared with Germany's forty-eight board feet. Gradually we shall reach the German level. This will reduce the demand upon our remaining supply of timber and help make it sufficient for all legitimate needs. This does not imply, however, that there is a timber famine by any means. Up to now timber of all kinds has been cheap and abundant, but soon some kinds will be scarcer than others and some grades will be higher in price. There will be a great supply of the common grades of building lumber for many years. It is estimated that there are 2800 billion feet of standing timber against an average consumption of 50 billion feet a year. This will furnish cutting for 56 years at the present rate from the present stand. Natural reproduction or growth will add to this, while the annual consumption of timber will be much lessened.—W. E. FRUDDEN.

The Barber-Pole Aiming-Point Used in Artillery Firing

ALMOST all artillery firing practice in the present war has been done with the use of an aiming pole. This is a device which enables the gunners to get an angle of deflection so that they can lay their guns on a target without seeing it. There are but few designs for these poles. The red and white pole, painted in effect similar to that of a barber pole and reinforced at one end with a spike so that it may be thrust into the ground, is about the newest design. Red and white are the most contrasting colors and are among those most easily visible in all kinds of weather. The poles are placed about 50 yards from the guns. The farther away the aiming point the better.



Aiming pole painted like barber pole

Poles of this kind may be easily made and painted like a barber pole by wrapping a piece of paper around the body of the pole in a spiral form, leaving a part uncovered, which may be painted; then, when it becomes dry, the other uncovered portion may be painted.—DUDLEY HESS.

Using Molten Lead Safely in a Damp Mold

MANY mechanics have had their patience sorely tried when pouring lead around a wet or damp joint, to have it explode, or scatter from the steam generated by the heat of the lead. This blowing may be avoided by putting a small piece of resin into the ladle and permitting it to melt before pouring the lead.

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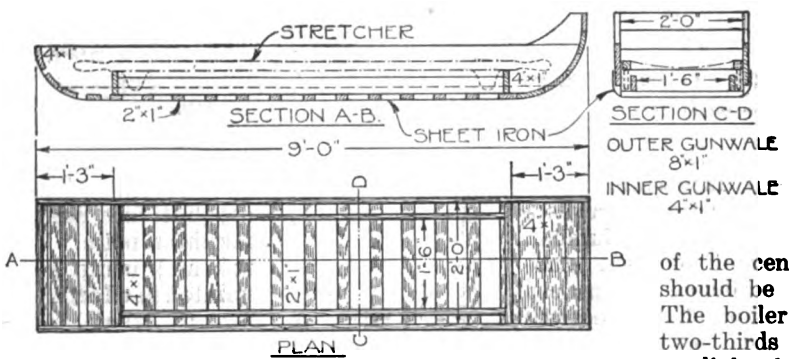
Tobogganing Over Flanders Mud in a Mud-Toboggan

THOSE of our readers who live in the northern states and Canada are quite familiar with the carrying power of the Canadian toboggan on soft snow; but the idea of a similar vehicle for negotiating mud will probably sound rather bizarre to them. In spite of this, such things do really exist. They are still another result of the topsy-turveydom which the war has created.



This mud-toboggan was made to rescue soldiers in Flanders where wheeled vehicles could not be used

It was found that wheeled traffic was oftentimes impracticable in the field of operations "over there" on account of the all-pervading mud, and so the officers cast about to improvise a means of getting around the difficulty. The novel mud-toboggan illustrated is the result. It has an iron bottom with wooden gunwales, and is practically spoon-shaped. It had to have a very low center of gravity to avoid overturning on uneven ground, and the sides were necessary to keep out the mud. The whole structure is streamlined in long curves so as to give the least possible resistance to traction.

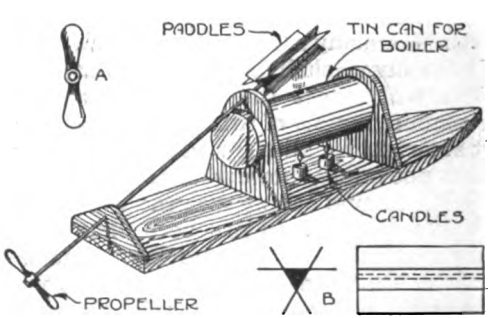
The vehicle is designed primarily to carry a stretcher, and this rests on two blocks of wood in the bottom of the toboggan, thus using the weight of the occupant to steady the vehicle without allowing him to touch the bottom or detracting from his comfort. It will carry one stretcher or 200 lb. of supplies.

Such a toboggan could be made use of for many like purposes where the ground is so soft that a wagon would get stuck in it.

A Toy Boat with Steam-Boiler That Turns a Propeller

THE boiler for this steamboat is a baking-powder can held in a horizontal position between two upright standards 3 in. from the base board of the boat. Under this can three candles are placed. In the upper part of the can, and 1 in. to one side of the center, a small hole should be made with a nail. The boiler should be filled two-thirds full before candles are lighted and the top must be soldered on. Future filling can be done through the small hole in top of the can.

The propeller is constructed as shown at *A* and fastened on to a stiff wire shaft as shown in the illustration. This shaft is held in an inclined position by means of two standards and the end which comes over the boiler has the paddles. Construction of the paddles is shown at *B*, the center being a triangular stick of wood three inches long with its faces one-half an inch. Upon this the tin leaves of the paddles are nailed.



The force of the escaping steam striking the paddles turns the propeller shaft

When the water in the boiler begins to boil the steam will burst out through the hole in the top of the boiler. This steam strikes against the leaves of the paddles and turns the shaft, which will propel the boat about in the water. The base of the boat may be of any desired shape.

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A Drop—and You Have a Microscope

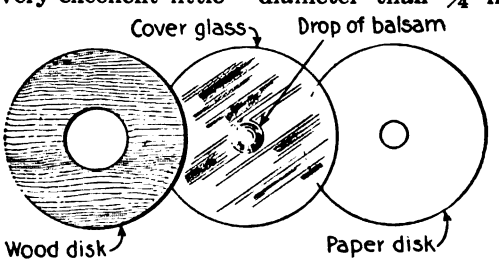
Making a high-power magnifier with a drop of Canada Balsam

By W. S. Standiford

WHILE almost every one has heard of the wonderful powers of the microscope, yet but few have ever had an opportunity to look through a high-powered one. Fewer still have been able to possess a really good instrument. The high price of the instrument will always prevent its common use, for a serviceable microscope cannot be purchased for less than $25, while the more expensive ones cost several hundreds of dollars. And yet a very excellent little microscope may be made at home in a few minutes by any one and at a cost next to nothing.

First of all, purchase a small quantity of Canada balsam and a dozen cover glasses from some dealer in optical goods. These cover glasses, as they are called, are used in mounting objects for the microscope. They are about as large around as a penny and as thin as a sheet of writing paper. This is all you need to purchase and the outlay should amount to only a few cents. Any one who has noticed how water spilled on a tablecloth magnifies the fibers of the cloth will understand the principle upon which these lenses are to be constructed, only we shall use the Canada balsam instead of water.

To make a microscope, take a clean cover glass and in the center place a small drop of balsam. Your microscope is now complete; that is, the part that does the magnifying is finished. It is therefore very important that this part should be well done. It is best to use a common ordinary steel needle for placing the drop of balsam on the cover glass. Dip it well into the balsam. On raising it you will find that the balsam runs slowly down to the point, very much as molasses would. The drop thus formed should be placed carefully in position in the center of the glass, and great care must be taken to make it exactly round. A number of these microscopes should be made of different sizes. Each one will then have a different magnifying power, the rule being that the smaller the drop, the more it will magnify. As it is difficult to make a nicely shaped large drop, it is best not to attempt one of a greater diameter than ¼ in. The large drops should be allowed to harden for a time before use. If the first drop is not perfect, clean the cover glass with a little benzine, and try again.



A cover glass, a wood and a paper disk make up the main parts of the microscope

The microscope as thus made, can be used just as it is, but it is best for ease in working to have some kind of a mounting. A very good mounting may be made as follows: In a piece of paper the size of the cover glass, cut a small circular hole, not quite as large as the drop of balsam. Paste this on the reverse side of the cover opposite the drop. This forms what is called a "diaphragm," and prevents the light from the edges of the drop from interfering with the accurate working of the lens. Next make a small circle of thin wood, and in the center of it bore a hole a little larger than the drop. Gum the cover glass on this so that the drop will come on the inside. Thus you will not only be able to handle the delicate cover glass freely, but you will also protect the drop from dirt and from the effects of handling while it is hardening.

After the microscope is made, the next question is how to use it. For examining mounted transparent objects or slides, it may be used like an ordinary magnifying glass. Hold the slide up toward the

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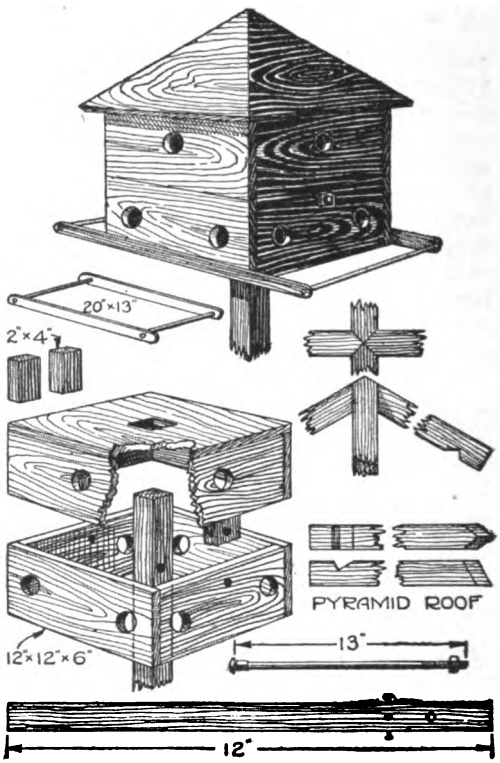
light. As the distance between the object and the lens for a clear definition—or focus—of the lens of all these microscopes is very short, the microscope should be placed against the slide and then moved slowly away until the proper focus is reached. The eye should be placed very close to the lens.

If you wish to examine the water animalcules, as they are called, use the following simple device. Take a plain slide from common window glass, about 3 in. long and 1 in. wide. On its center place a cell or round ring of wax, small enough to be covered with one of the circular glass covers and deep enough to contain a good-sized drop of water. This slide will answer all the purposes of a store-made affair costing two dollars or more. To use it, put the drop of water that you wish to examine in the wax cell and drop a cover glass upon it, thus flattening the curved surface of the drop, so that it may be examined without the image being distorted thereby. The slide may be viewed just like any mounted object.

The magnifying power, as has been said, varies with the size of the drop of balsam used. A drop ¼ in. in diameter will magnify to about 15-diameters; a drop half that size about 30-diameters, while powers of one, two or even three hundred diameters may be readily obtained. When it is realized that the ordinary pocket lens rarely magnifies more than 5 diameters, an idea of the immense powers of these microscopes will be arrived at. In examining pond water, however, only the lower powers should be used. Use the lowest first and increase the power until the best results are reached.

Making a Take-Down Birdhouse for Cleaning

BIRD conservation received a great impetus last year owing to the interest taken by the leaders of great organizations, and thousands of bird houses were erected in parks and nearby woods. After one season's use by feathered tenants a domicile, however carefully designed, is practically useless until it is thoroughly cleaned, which is well-nigh impossible when ordinary lines of construction are followed. The illustration shows a very simple birdhouse built with the idea of being taken down and cleaned regularly. It consists of a box made in two parts. On the inside of the upper portion cleats are fastened and extend down over the edge. Holes are bored ½ in. in diameter in the projecting ends



The parts of this birdhouse are separable so that it may be taken apart and cleaned

and the ½-in. bolt passes through them and locks the parts together immovably. The same bolt also extends through a hole in the upright post. The perch frame is separately made and nailed to the bottom of the house. The pyramidal roof is laid out as shown and permanently nailed to the upper part of the box. To clean the house or take it down it is only necessary to remove the nut, withdraw the bolt, and lift off the sections. All inside surfaces should be washed out and exposed to sunlight for several days before again setting up the house. Only a yearly renovation is contemplated by the design given. There is nothing, however, to prevent a more frequent clean-up.

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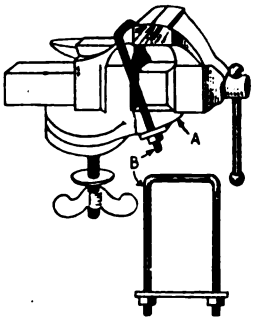
Mending a Broken Vise with a Clamp

A CARELESS workman using a bench vise for an anvil broke away a part of the base, as shown at *A*. This let the sliding jaw sag, putting the tool out of commission. The broken piece was clamped in place by the saddle clip *B*, and the vise worked as well as ever. The clip was forged from a machine steel rod with a rectangular cross piece of the same material held with nuts.—T. H. LINTHICUM.

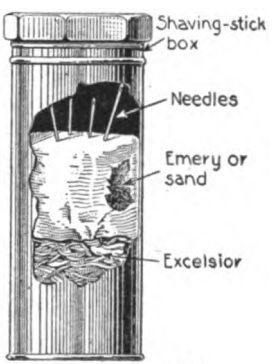


The saddle clip shape and how it was used

A Safe Case for Holding Needles Cleanly Without Rust

NEEDLES are so commonplace that the inherent danger in their use often is not brought forcibly to mind until an accident occurs. A needle, carelessly dropped on the floor, is a menace to the bare or stockinged feet of children and adults, and a needle, if broken in the foot, may lead to serious consequences.

In the accompanying illustration is shown a convenient needle case, that any boy easily can construct for his mother or sister. The materials required are an empty metal box, such as shaving soap is sold in, a piece of worsted, or other cloth of an elastic nature about 5 or 6 in. square, and small quantities of excelsior and emery, or fine sand. Approximately a heaping tablespoonful of the emery or sand is tied in the piece of cloth and the excelsior and emery inserted in the box in the order named, as illustrated. If a small quantity of glue is smeared on the inside of the box, its contents, when inserted, will be securely held in position. If mother has this handy case, she will not be tempted to stick her needle in the window curtain and, moreover, the emery will keep her needles scoured clean.—C. J. BRICKETT.

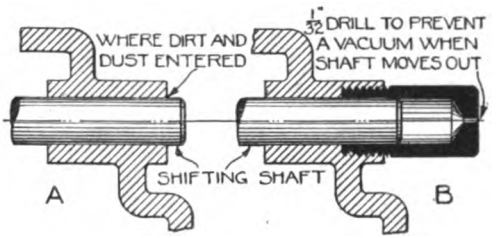


Inclosed emery bag to protect needles

Preventing Dirt from Entering a Shifting Shaft Bearing

TROUBLE often occurs when shifting the gears of an automobile. In many cases the difficulty can be traced to such cause as shown in the accompanying illustration.

The part at *A* illustrates the manner in which grit and dust may readily work their way inside the gear case. The constant movement of this foreign matter rubbing against the aluminum case and the steel shaft in time prevents smooth action of the latter when the gears are being shifted.



A supplemented piece of steel used as a cap to prevent dust entering the bearing

The repair may be made by providing a piece of steel rod, bored out to a diameter a trifle larger than that of the shifting shaft, and to such depth as to enable the shaft to move the proper distance. The added piece, as shown at *B* in the foregoing diagram, is fastened through the medium of a thread.—ADOLPH KLEIN.

Tightening the Cane in the Bottom of a Chair

CANE chair bottoms will, in time, sag in the middle and the cane will eventually break out at the edges. To tighten the seat proceed as follows: Turn the chair bottom upwards and rub the cane thoroughly with hot water until it is well soaked. Should it be dirty, use a little soap. Let it dry in the air and it will be as tight and firm as when purchased.

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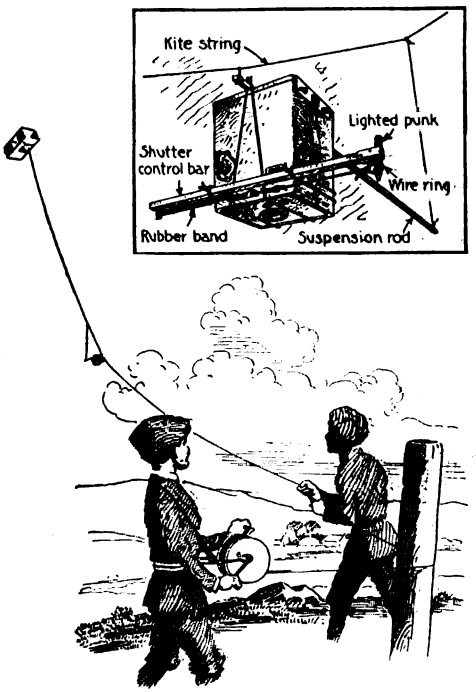
Aerial Photography with a Box Camera Held Up by a Kite

WHILE the photographs are not as clear as those required on the battle front in Europe, very interesting pictures of limited areas may be made, automatically, from considerable elevations with a small box camera suspended from a large kite in the following manner.



Attaching a box camera to a kite line for using it to take aerial photographs

A shutter-control bar of white pine is wired to the camera in the position shown in the detail. One end of this bar supports, in a sheet metal holder, a piece of ordinary "punk" such as is used to light Fourth of July fire-crackers, and the opposite end has a wire nail projecting downward from it. The shutter operating lever of the camera is then provided with a double-end wire loop which is passed through a small hole previously drilled in the lever.

The camera having been loaded, the shutter-lever is held in its set position, ready to make a "snap-shot" by means of a cord, which is attached by one end to the wire loop, and by its other end to a small wire ring which is passed over the piece of "punk," as shown. A rubber band is then stretched from the opposite wire loop to the wire nail, the refractive force of the rubber band being now supported by the piece of "punk."

The camera having now been attached to the kite string, as shown, the piece of "punk" is adjusted downward at a distance proportional to the pre-determined time at which the "snap-shot" is to be taken. The punk is then lighted.

The kite string is now payed out a sufficient distance to raise the kite, bearing the camera with it, to the desired elevation and it is then held in position a sufficient period to permit the "punk" to burn upward to the position of the wire ring, at which time the ring, by reason of the pull of the rubber band thereon, cuts through the ashes and allows the shutter-lever to operate to make the "snap-shot." The kite is then pulled down far enough to reach the camera, when a fresh film may be reeled off, and the "punk" and the shutter re-set for another exposure.

The photographs secured in this novel manner may be made more interesting by having enlargements made from them.

A Bicycle Pump to Clear a Drain Pipe

WAR demands make plumbers scarce and for this reason a residence owner had to clear his own water drain pipe. To do so he had to make some sort of a force pump, and he selected a bicycle pump for the purpose. The rubber hose was detached and the hole plugged. The entire bottom section was removed, leaving the end of the cylinder open. A large hollow rubber ball, having a larger diameter than the drain opening was procured, and cut in half. The center of one-half was cut out to make it fit tightly over the pump end. It was further secured by a few turns of fine wire.

This arrangement made a large syringe with the lower end cupped downward. The sink was filled with a strong solution of lye and hot water. Using the pump as a large syringe over the drain opening, the solution was forced into the pipe and it was cleaned neatly and quickly.—M. M. CLEMENT.

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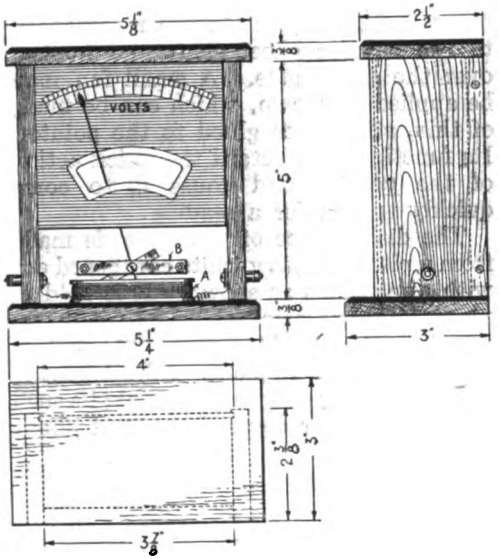
How to Construct a Voltmeter for Experimental Work

THE first essential of a good, substantial, portable voltmeter is a case in which to inclose the working parts. Such a case is dimensioned in the illustration. The side walls, top, bottom and back are preferably made of oak for



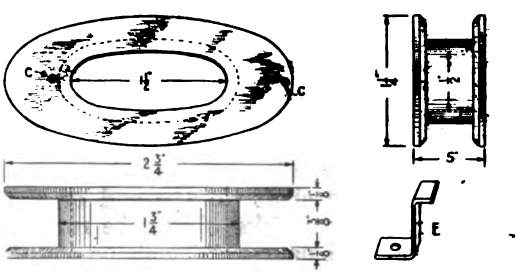
The case is made of oak held together with screws to inclose the working parts

durability and appearance. The whole case is joined together with screws put into small drilled holes that are countersunk to prevent splitting the wood. The front is of glass placed into small grooves like a sliding cover to a box.

All voltmeters, with the exception of the chemical types, have one or more coils of some type or other. In this voltmeter the coil is located at *A*. The coil has no metallic core and is wound on a spool shaped as shown from a piece of soft pine. It has a hollow center to allow for the movement in the frame *B*. The dimensions given for this spool may be altered to suit requirements.

When the spool is complete, drill a small hole through the side wall as shown at *C* for one end of the wire. In winding this coil use No. 34 or 36-gage wire. The finer the wire in the coil, the more turns can be put on it, and the more turns of wire the more sensitive voltmeter. This statement is true within a certain limit; for when the outside turns on the coil become so long that their resistance overbalances their magnetic effect, then extra turns will be of no use. The spool should be wound full. When starting to wind the coil it is a good plan to run a piece of somewhat larger flexible wire through the hole at *C* and then solder the fine wire to this on the inside, insulating the joint with thin paper. This plan is recommended; for if the fine wire is run through the hole on the outside it is apt to break off and will cause trouble in making the connection. The coil may be wound in either direction. The end of the wire from the outside coil should be run through the small hole at *D*. To give the two ends of the coil an appearance of uniformity a larger piece of flexible wire may be run through this hole and soldered to the fine wire on the inside. When the coil is finished it should be completely immersed in hot paraffin for about one minute. This coating of paraffin makes the coil moisture-proof and protects the insulation. The coil is then mounted in the center of the base of the voltmeter case by means of two small clamps shown at *E*. Connection is made from the two ends of the coil to the two binding-posts on the side of the case.

It is now necessary to have a moving part operated by the magnetism set up by the coil to register the voltage. The delicacy of the instrument depends greatly on the freedom with which this part of



The dimensions of the spool which is made of soft pine without a metal core. Extra fine wire is used for the coil

the voltmeter may be moved, therefore friction must be reduced as low as possible. A pivot-bearing is very practicable and is easily obtained from the works of an old alarm clock. Cut off the ends of the

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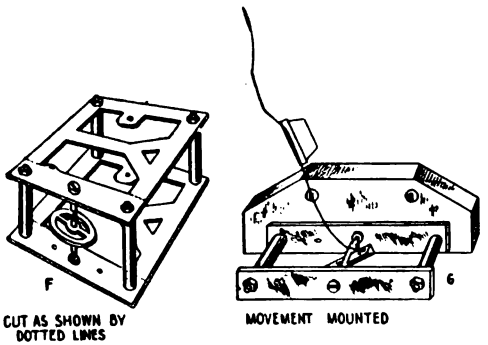
frame as shown by the dotted line in *F*, leaving the two corner posts which hold the strips together with the balance wheel bearings. The rough corners and edges caused by the cutting should be removed with a file. Two small holes are then drilled in the brass strip which holds



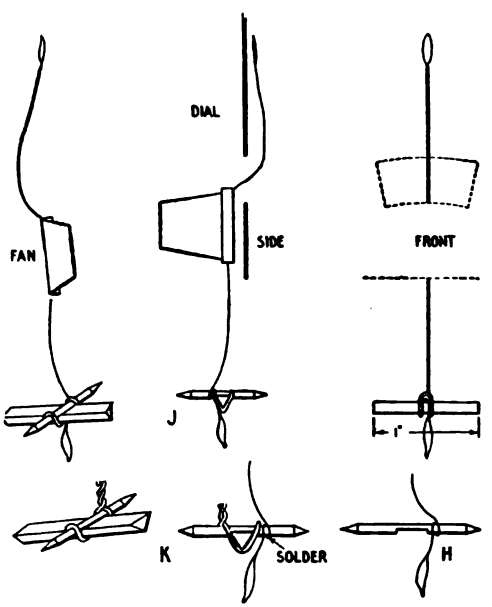
Part of the works of an old alarm clock is used for the necessary pivot bearings

the fixed bearing of the balance wheel, one on each side of the bearing, half way between it and the posts which hold the frame together. These holes are used to fasten the frame with small screws to a block as shown at *G*. This block in turn is screwed to the back of the case.

Obtain the balance wheel from the old clock and carefully remove it from its shaft, taking care not to bend the shaft or batter its points. The next thing to make is the pointer or hand for the voltmeter. A piece of brass or copper wire about 6 in. long of No. 22 or 24 gage is used. About 5 in. from one end make a close turn around the balance-wheel shaft ¼ in. from the center as at *H* and fasten it with solder. The short end of the wire should be turned back on itself so that it will project about ⅜ or ½ in. below the shaft. After the pointer has been bent into shape and cut off so that it is 4 in. long from the shaft to the end of the pointer, enough solder should be run on it to make it balance. The shape of the pointer and its relative position to the dial or face of the voltmeter may be seen in *J*.

The shaft is then flattened on one side with a file as shown at *H*. This is to fasten a permanent magnet made of a three-cornered file. The file is ground smooth and charged by holding it across the poles of a permanent magnet, or better still, across the poles of an electromagnet. The magnet is then mounted temporarily at *K* and soldered, using an alcohol flame, after which the holding wire is removed. Owing to the pointer being perfectly balanced it will stand at the center of the scale when there is no current in the coil. To bring the upper end to zero it is necessary to have a light spring attached. This can be made of a coil of light spring brass wire attached to the balance-wheel shaft and hooked over the frame side. A small fan may be applied as shown, which can be made of thin, stiff paper glued to the pointer. Its function is to retard the quick action of the pointer and cause it to come quickly to rest for a reading.

The dial or face of the meter is made from a piece of heavy white cardboard cut with dimensions as shown. It is held in place with two small strips of wood fastened to the side of the case. The scale is put on after it is in place. Adjustment of the light spring and weight should be such that the pointer comes to rest at about



The shaft or pivot with its cardboard fan and pointer for the dial of the voltmeter

¼ in. from the extreme left side of the dial. This is the zero point which permits the pointer ¼ in. freedom from the start. This is to detect a current passing through in the wrong direction.

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It is now necessary to calibrate the dial, and to do this properly a commercial voltmeter must be obtained. One of these can be borrowed for the purpose. The terminals of the coil are connected in series with the voltmeter and a cell or battery. While it is not necessary to use a large resistance in connection with the work it will make the calibration more convenient. If it is used, it should be large enough to vary the current obtained from the batteries so that a difference of about ¾ volt is registered by the commercial voltmeter. Then when one cell is connected, the resistance is adjusted until the commercial voltmeter registers exactly one volt. The position of the pointer on our home-made meter will register one valt wherever the pointer comes to rest. It is so marked; then two cells are connected in the place of one, and the resistance adjusted until two volts are registered on the commercial voltmeter. Where the pointer comes to rest on the new one, mark it two volts, and so on until the dial is completely calibated.

If an ammeter is desired instead of a voltmeter, exactly the same procedure may be followed, except that the coil on the spool should be wound with from two to four turns of large wire such as No. 14 or 12 copper magnet wire. The fewer the turns of large wire the higher will be the amperage capacity of the instrument.

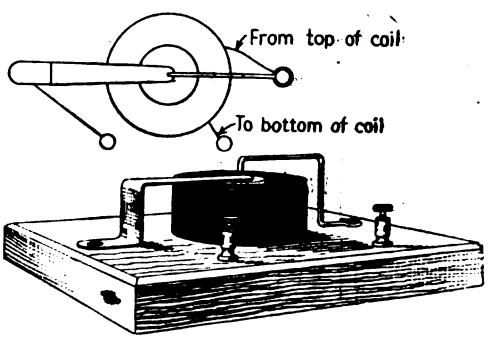
A combination volt-ammeter may be made from this instrument by first winding about three turns of heavy magnet wire on the spool, then winding the rest of the space with fine wire, taking care to wind the fine wire in the same direction as the heavy wire. Connect one end of the fine and the corresponding end of the large wire together under one binding-post. Then connect the other end of the fine wire to another binding-post, and the other end of the large wire to still another binding-post. Mark the binding-post to which both the fine and large wire are connected "*C*" for common, that is, common to both ammeter and voltmeter. Mark the post to which the fine wire is connected "*V*" for voltmeter, and the post to which the heavy wire is connected "*A*" for ammeter.

When testing volts, connect one side of the circuit to be tested to the post marked "*C*," the other side to the one marked "*V*". When testing the amperage in a circuit, connect one wire to the post marked "*C*" and one to the post marked "*A*". In either case, if the pointer starts the wrong way, reverse the connection. The calibration is made in the same way as for the voltmeter, except that a commercial ammeter is used. If a combination colt-ammeter is being calibrated, the readings in volts may be put above the scale and the readings in amperes placed below, or *vice versa*.

When using the instrument it must be remembered that the principal part of the movement is a small permanent magnet and that it will be affected by an electric magnet force from without the instrument itself. This being the case, the instrument should be kept away from any outside source of magnetism, as for instance, an electric coil, or electric motor, or dynamo generator, or any kind of a permanent magnet.—BERT RODSON.

An Old Telephone Receiver Made Into a Buzzer

AN old receiver that has lost its magnetism can be easily made into a buzzer, as shown in the illustration. Make a base of wood and fasten the receiver to it with screws. The cap and diaphragm is not used. A strip of metal —steel, not brass—is bent as shown and fastened to the base so that its over-



An old telephone receiver with its coil mounted on a wood base to make a buzzer

hanging end will be close to the end of the magnet core. On the opposite side of the receiver make a similar shaped piece from a length of brass wire and fasten it to the base also. The overhanging end of this piece should be close to the overhanging end of the steel piece.

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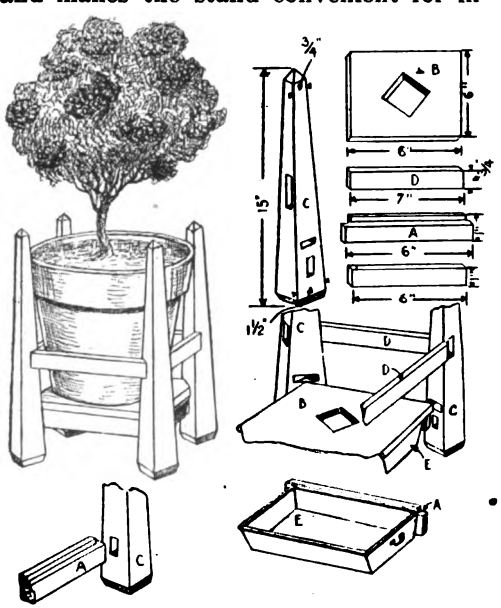
One end of the coil is connected to one binding post and the other is connected to the screw holding the brass piece to the base. The steel strip is connected to the other binding post. Slight bending of the overhanging ends of the brass and steel pieces will adjust their working points and make them buzz when the current is turned on the circuit. With a one- or two-cell battery in the line, and a push button or key, an efficient buzzer will be the result.—THOMAS MILLSPAUGH.

A Convenient Stand for a Heavy Potted Plant

THE sketch shows a tabouret or stand of strong and simple design to hold a flower pot. The tapered posts are 1½ in. square at the base and taper to ¾ in. at the top and are 15 in. long. Each part is shown with dimensions for making the stand. Cypress, white and yellow pine are the best woods to use. Under the shelf on which the pot rests are two rails having runners as shown at *A*. Upon them the drip pan rests or hangs with its upper edge or flange in the rabbet. It is easily slid in or withdrawn to be emptied and makes the stand convenient for in-

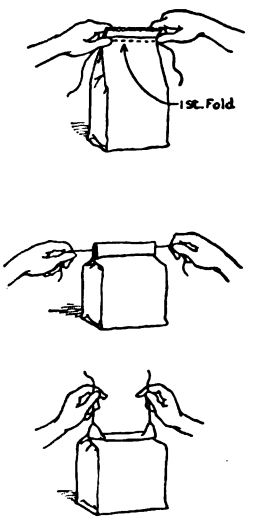


Details of the parts for making a stand in wood to hold a heavy potted plant

door use. The hole in the bottom of the flower pot is placed directly over the hole in the shelf *B*. This permits the seepage to pass through to the pan. Two coats of weathered oak or green stain and two of wax make a suitable and durable finish for the wood parts.—H. ADLON.

A Saving of Time and Twine in Tying Bags

A VERY clever method of tying a bag that will result in economy of twine and also of time is deserving of being better known. The old method required enough string to encircle the parcel two or three times before it was held securely and that needed from 20 to 36 in. of string for a moderately small package.



Folding the bag top over the tying string

The new method is as follows: Close the bag according to the old method. In the first fold place the string and fold as often as is necessary after that to adequately close the bag. The corners are then turned toward the center and flattened. This brings the two ends of the string together to be tied. The finished package is neat and firmly tied, presenting a pleasing appearance, and what is unusual, only four or five inches of the string is required to make the tie.—EMILE PARENT.

Repairing Leaks in Aluminum Ware with Rivets

IT takes more than average experience to repair a leak in aluminum ware by soldering. An easy method of effectively repairing small leaks is to ream out the hole to a diameter that will accommodate a piece of aluminum wire. A short piece is passed through the hole and riveted in place with a hammer until the surface of the metal is practically smooth. If aluminum wire cannot be obtained, a piece of soft copper wire or wire solder will answer the purpose.

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Electrical Devices and How They Work

VIII.—Principles of direct current dynamos

By Peter J. M. Clute, B. E.

A DYNAMO-ELECTRIC generator is a machine for converting mechanical energy into electrical energy; in other words, it generates electric current when driven by mechanical power. The term "dynamo-electric generator" is so long that it is usually abbreviated into "dynamo," which bears the same meaning. The name "generator" is commonly used when the machine generates electricity, in order to distinguish it from the "motor," which is also a dynamo-electric machine.

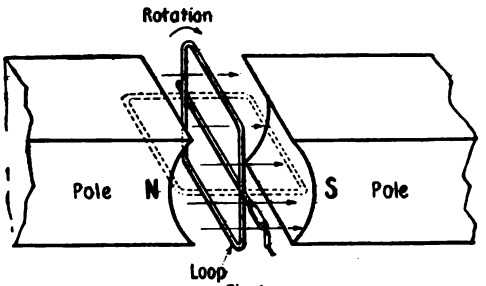

Fig.1

An ideal method of dynamo construction with two poles and revolving armature

An electric motor converts electrical energy into mechanical power; or, rather, it produces mechanical power when supplied with electric current. A dynamotor, motor-dynamo, or motor-generator, is, as its name implies, a combination of the two machines, and consists of a motor and a generator, either directly coupled together or built as one machine. It is used to transform electrical energy at a certain potential into energy at a higher or lower voltage, with a corresponding decrease or increase in amperage. When used to convert direct into alternating currents, or the reverse, a single armature winding usually performs both motor and generator functions, in which case the machine is called a "rotary converter."

The dynamo is based on the discovery that an electric current is generated in a conductor by moving it in a magnetic field. The electric motor works on the principle that a conductor carrying a current in a magnetic field tends to move. Thus they are exactly the reverse of each other in action.

The two machines are, however, very similar in construction. In fact, the same machine can be used equally well for either purpose. They are generally made slightly different, but this is only done to adapt them more definitely to certain needs.

It has been stated that both generator and motor depend for their action upon the movement of conductors in magnetic fields. Experience has proved that the best way to carry out this principle is to arrange the conductors in suitable form and rotate them between the poles of a magnet, or magnets, permanent or electrically excited.

Every D. C. dynamo consists of three essential parts: (*A*) The field magnet to produce a powerful magnetic field; (*b*) the armature, consisting of an iron core on which is wound a system of conductors, revolving in the magnetic field in such a way that the number of lines of force cutting the conductors varies continuously; (*C*) the commutator, and brushes, for giving a uniform direction to the alternating currents in the coils by their rotation in the magnetic field.

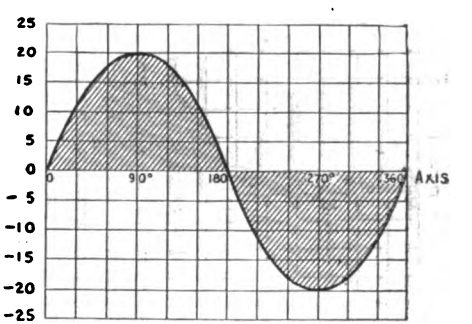

Fig.2

A curve of the electro-motive force of an ideal and simple electric dynamo

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In the consideration of the underlying principles of the electric generator, it will be found convenient to consider a single conductor in the form of a loop, revolving between two magnet poles

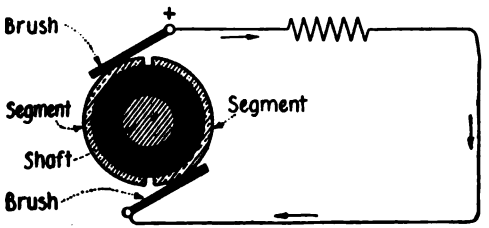

Fig.3

When the armature-coil is simple the commutator consists of only two parts or a split tube

about a horizontal axis in the direction of the arrow, as in Fig. 1. In the position shown, the loop encloses the maximum flux or lines of force, but since there is no change in the flux enclosed, the induced E. M. F. is zero. By rotating the loop a quarter-turn, its plane will be parallel to the direction of the lines of force, as shown by the dotted lines, and consequently no flux will pass through it. In rotating through this quarter-turn, the decrease in flux threading through the loop generates in it a direct E. M. F., whose direction is indicated on the loop by arrows.

In the next quarter turn, there is an increase in the lines of force through the loop, but since the loop has turned over, the flux passes through it in the opposite direction. This is practically equivalent

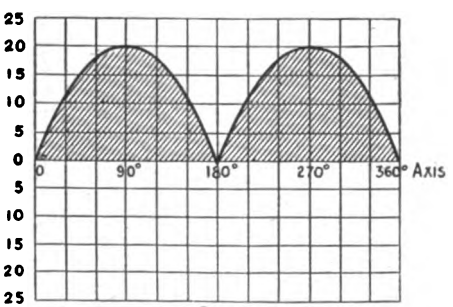

Fig. 4

Rectified electro-motive force curve of a simple dynamo with a two-part commutator

to a steady decrease in the original direction and thus the E. M. F. induced in the loop is in the same direction for the entire half-turn. When the half-turn is completed, the value of induced E. M. F. is again zero; and if the loop be further revolved, the E. M. F. is induced in the opposite direction, around the loop. If there are several turns in the loop, the induced E. M. F. reverses in all of them twice every revolution.

The curve in Fig. 2 shows the induced E. M. F. in such a case, where the coil rotates with uniform speed. The curve starts with coil in a vertical plane, the abscissa at any point is the angle through which the coil has moved, and the corresponding E. M. F. is the ordinate, drawn above the horizontal in one direction, and below when it is reversed. Thus, when the plane of the coil has revolved 45 deg. the induced E. M. F. is about 15 volts, and 90 deg., 20 volts, etc.

The current produced is what is termed an alternating current and goes through a complete cycle of changes for one revolu-

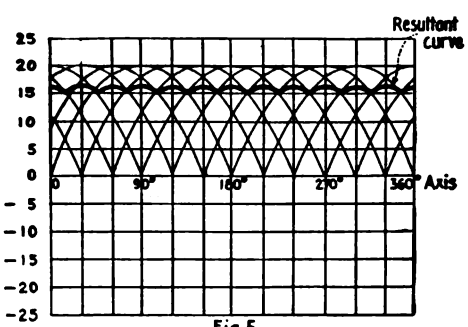

Fig.5

With numerous coils and commutator bars a direct constant current is obtained

tion of the armature. To convert these alternating currents flowing in the armature into a uni-directional current in the external circuit, a commutator is employed. It works on the principle that if the connections of the armature coils are reversed at the instant when the current in the coils is reversed, the induced currents will all flow in the same direction through the external circuit.

For a single armature coil, the commutator consists only of two parts. It is a split tube with the two halves or segments insulated from the shaft by a bushing of insulating material and are separated from each other as in Fig. 3. The ends of the coil, shown in Fig. 1, are connected with the two segments. Two brushes, to which the external circuit is connected, bear on the commutator, being so placed

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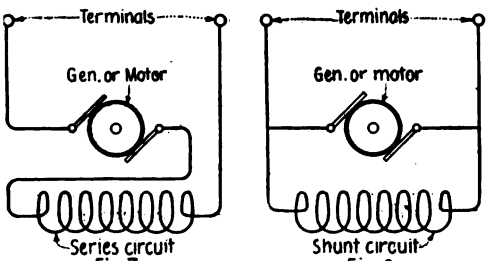
as to make contact with the two commutator segments at the instant the current reverses in the cog. Thus one of the brushes is always positive and the other negative, and current circulates in the external circuit from positive brush back to negative, and thence through the coil again to the positive. With a single coil the current is pulsating, or falls to zero twice every revolution (Fig. 4). If, however, as in practice, a large number of coils are placed around the armature core and connected with separate commutator bars similarly as before, there will be obtained a series of successive composite pulsating currents, whose effective value approximate a constant current, as shown graphically in Fig. 5.

Fig. 6

A typical armature punching made of soft iron

For D. C. generators, the most common form of armature is the drum armature. The core is made up of thin disks stamped out with teeth around the periphery. Figure 6 shows one of these armature laminations. The armature core should be laminated; this is done, because if the core were made of one solid piece of iron, it would have useless eddy, or Foucault, currents generated in it, which would waste a great deal of the power of the machine.

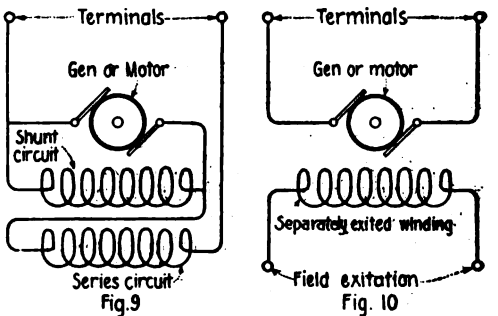


Diagrams showing one for a series winding and the other for a shunt winding

When assembled on the shaft, the slots form grooves in which the armature windings are placed. The armature coils may all be joined in series, and the common junctions connected with respective commutator segments. The E. M. F. generated in the armature depends on three factors: the number of lines of force cutting the armature coils, the number of revolutions which the armature makes per second, and the number of coils composing the winding.

The magnetic field in which the armature revolves is produced by large electromagnets generally excited by the armature current. When the entire current is led around the field coils, the dynamo is said to be series wound (Fig. 7). When the field is excited by coils of many turns of fine wire connected as a shunt to the external circuit, the machine is said to be shunt wound (Fig. 8). A combination of these two methods of excitation is called compound winding (Fig. 9). When the magnetizing current is supplied from an outside source the dynamo is said to be separately excited (Fig. 10).

In the series-wound generator, the



The first is for compound winding and the second is a separately excited field

whole armature current passes around the field magnets and through the external circuit. Any resistance put in the external circuit, causing the current to diminish, weakens the magnetic field and therefore decreases the E. M. F. of the machine. When there is no current flowing, its E. M. F. is zero except for the residual magnetism.

In the shunt arrangement the armature current is divided, part flowing around the magnets and part to the external circuit. In order that but a small current may be taken for the magnet, it is wound with many turns of fine wire. The current through the shunt coil depends only on its resistance and on the potential difference at the brushes. Hence it is constant and the magnet strength is con-

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stant as long as the potential difference remains the same. The E. M. F. of such a machine is nearly constant, but is slightly greater when no current flows in the external circuit, for with increasing external current there is more current

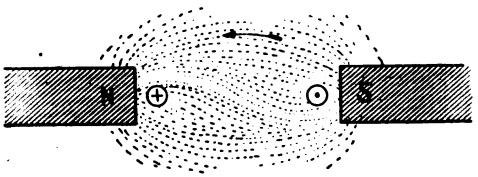

Fig. 11

Distortion of a magnetic field by a current carrying loop tending to turn it counter-clockwise

and a greater fall of potential in the armature itself.

Compound winding is a combination of the series and shunt arrangements. In this way, a dynamo may be made to maintain a nearly constant potential at the terminals, though the external current may vary greatly; or it may be over-compounded so that its terminal E. M. F. may be greater with large currents than with small.

Thus far, we have considered the ideal simple dynamo as a generator. Let us now consider its operation as a motor.

An electric motor is a machine in which electric current gives motion to an armature, this producing mechanical work. The D. C. motor is constructed in the same manner as a generator; in fact, any D. C. generator may be used as a motor. A study of the magnetic field resulting from the interaction of the field due to the field magnet and that of a single loop carrying a current will make it clear that such a loop has a tendency to rotate. Figure 11 shows the field distortion between magnet poles caused by a current passing through a loop of wire in the magnetic field. Many of the lines of force pass through the loop instead of passing directly across from one magnetic pole to another. As is well known, lines of magnetic force are under tension and tend to straighten out. In doing so, a magnetic stress is brought to bear on the current-carrying loop and tends to turn it counter-clockwise in the case shown in Fig. 11. If this magnetic effect is allowed to come into play, the loop will become the armature of a simple motor, and mechanical work will have been accomplished by the machine through the medium of the electric energy flowing through it. If, however, the loop is forcibly rotated clockwise by mechanical means, it will turn against the magnetic effort acting upon it, and work will be done against this magnetic stress. The loop will then act as the armature of a generator.

Direct current motors, like generators, are either series or shunt wound according to the service for which they are designed. Series motors are used where variable speed is required; shunt motors are employed where constant speed is desirable. High-speed motors are usually bi-polar; motors for slow-speed service have multi-polar fields.

The turning moment, or torque, of a motor is dependent upon the strength of the magnetic field and upon the armature current. In a shunt motor, the torque

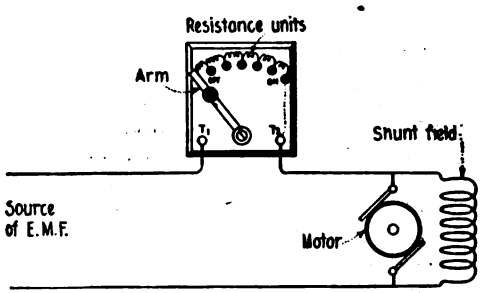

Fig. 12

Typical starting resistance for a motor with one line run directly to the motor

varies directly as the armature current, since the field strength is nearly constant. In a series motor, however, the field strength varies nearly as the current, as the current is the same through field and armature; hence, the torque varies as the square of the current in the series motor. This type of motor is, therefore, used principally where a heavy starting torque is required.

While the motor is running mechanical work is being done in addition to the energy dissipated as heat in the armature due to its resistance. But the total energy spent in the motor is equal to the product of the current strength and the potential difference of the brushes. Hence, if the current is kept constant, the difference of potential between brushes must be greater

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when the armature is running and doing work than when it is at rest. This increase in potential difference at brushes due to the armature rotation is the back E. M. F. of the motor. This is due to the fact that the motor, while running, acts like a generator and develops an E. M F., which acts in opposition to the E. M. F. of the source of supply to the motor.

The resistance of a motor armature is small, and a motor at rest has no back E. M. F. to limit the current at starting. If, therefore, the current were applied without temporary starting resistance in circuit, there would be a heavy rush of current, which might damage the motor. So, the use of a starting-box—rheostat with graduated resistance units, is desirable.

Referring to Fig. 12, one line lead is connected directly to the motor while the other is joined to the terminal of the starting box, as shown. The other terminal of the starter is connected with the motor. When the switch is turned to the second button of the starter, the current flows through the resistance units and starts the armature. As the speed increases and more back E. M. F. is developed, the switch is moved to the next points, reducing the resistance with each step, until, as the armature comes up to full speed, the switch makes direct connection, and the back E. M. F. keeps the current moderate even though the armature resistance may be quite low.

(*To be continued*)

An Easy Method of Renewing Used Carbon Paper

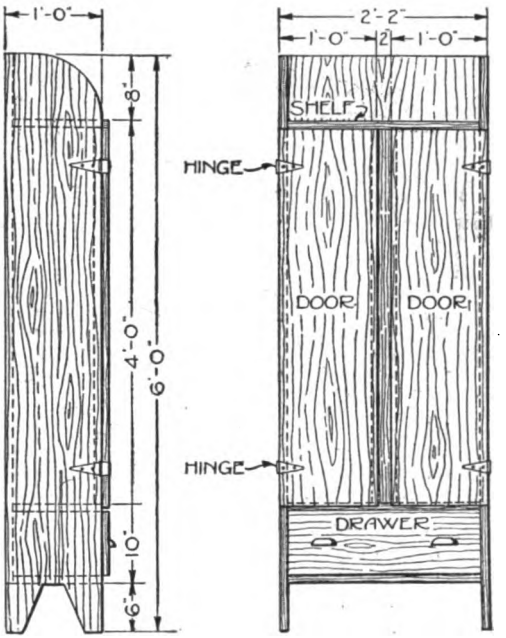
YOUR used carbon or transfer paper can be made to last much longer by simply holding it over an open flame such as a lamp, candle or match, with the carbon side down. The wax substance of the unused parts will melt and run into the thinner sections of the parts which are worn out.—E. M. THAYER.

An Efficient Primer for Starting Gasoline Engines

SPEAKING of anesthetics in connection with automobile troubles, it will be found valuable to remember that a mixture of half ether and half gasoline used as a primer, will often start an obstinate engine when all other means fail.—PETER J. M. CLUTE.

How to Make a Simple Wardrobe for the Camp

THE illustration shows the construction of a very simple wardrobe for a soldier's camp. It can be quickly made



A wardrobe for the camp which may be constructed of packing box material or scrap lumber

from any cheap lumber. Material taken from shipping boxes does very well.

The ends are made up of two boards 6 ft. long and 1 ft. wide, or can be constructed of two narrow boards. The boards forming the back are 5½ ft. long and are nailed to the cross shelves or partitions holding the ends together. A drawer is fitted in the bottom and an 8-in. space is left at the top for a shelf. The wardrobe part is provided with two doors.—GEORGE M. PETERSEN.

Using an Egg Beater to Mix Dry Color in Paint

MIXING dry colors in ready mixed paint with the ordinary paddle to get the desired shade is a decidedly tedious job and unless thoroughly mixed will be streaked and spotted when applied with a brush. A much quicker method of accomplishing the mixing is to use an egg beater, which also eliminates the skin and other foreign matter from the liquid.

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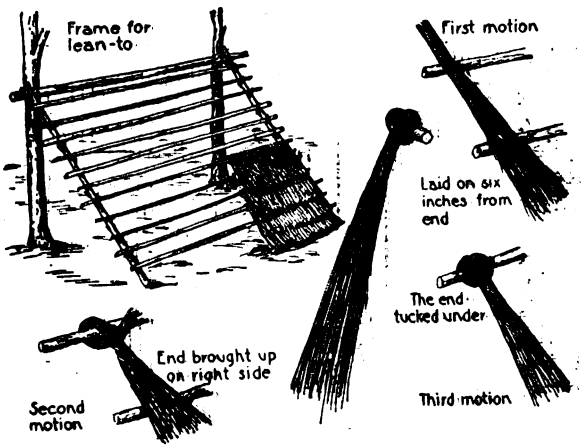
How to Make a Thatched Lean-To in an Emergency

WHEN the boys found themselves far from the camp and miles from any habitation, with great storm clouds forming in the west, they knew it meant an all-night stay in the open. As they had neither water-proof coats nor blankets and no hillsides were available, shelter had to be improvised, and improvised quickly.



Poles cut to place against two trees and the method of making the thatching material for covering the poles

They solved the problem in the following manner: Selecting a spot where they found two conveniently-located trees standing about 6 ft. apart, they cut a young sapling 8 ft. long, and two smaller ones each 7 ft. long, these latter ones having a fork at one end. The long sapling was held against the trees horizontally, at an elevation of 5 ft., and the two forked poles were planted in the ground 5 ft. from the trees. They were then leaned over to the trees so that the horizontal sapling rested on the forks. In this way the frame work for a lean-to was provided.

A dozen small saplings, or poles, each 7 ft. long, were then cut and laid on the forked saplings 6 in. apart. As there was no cord convenient they used withes of grass to bind together the intersecting points. At the time the forked poles were cut care was taken not to cut off the branches too close up to the body of the sapling, so that each sapling had a number of spines sticking out. Some of these spines came in handy when the small poles were being applied, as they were laid in the crotches, and thus helped with the withes, to hold the poles in place.

The lean-to thus made had its open side facing the east, as they knew the storm was coming from the west. In case the wind should change its direction during the night, withes were used to bind the forked poles to the trees, and thus make certain that the structure would not be blown away.

Now came the problem of covering the roof frame thus formed. With their knives the boys cut the longest supple grass they could find, a species of wild timothy, the stalks of which were about 18 in. in length. They worked in pairs, one picking up handfuls large enough to form wisps about 1 in. thick, when tightly compressed and twisting them at the top sufficiently tight to form a compact mass, leaving the lower part straight. In this form they were handed to his companion who applied the twisted part to a pole at a point about 6 in. from the upper twisted end, the untwisted part of the wisp being directed downwards along the roof. The real art was in applying the wisp so as to accomplish two things—first, to attach it firmly to the pole; and second, to be sure that it would shed water.

It will be noticed that the wisp is twisted to the right. In that case the short end of the twist, after being bent under the pole, must be brought up on the right side of the body of the wisp, and then crossed over to the left and tucked under the body of the twist

This being done, the wisp is pushed over so that it rests tightly against the adjoining wisp, and the lower untwisted ends are spread out and intertwined, not twisted with the adjacent wisps. In this way the whole becomes matted together, providing a mass which is impervious to water, and able to withstand any air pressure from the under side.

A gable roof may be made by making another lean-to on the other side of the tree. Thus, a permanent house can be constructed which will outlast the season.

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Wireless Work in Wartime

XIII.—Further details of the radio receiver

By John V. L. Hogan

IN last month's article the general action of the complete contact-rectifier receiver of Fig. 47 was described; this illustration is again reproduced for reference here. In the diagram, the aerial wires are represented by A, the primary or antenna circuit inductances by L_3 (the load coil) and L_1 (the primary coil), the secondary coil by L_2, the secondary condenser by C_1, the contact rectifier by D, and the telephone and telephone condenser by T and C_2. The curves of Fig. 48 should aid in making clear the operation of the various elements, since the characteristic voltages and currents for each important part of the circuit are shown.

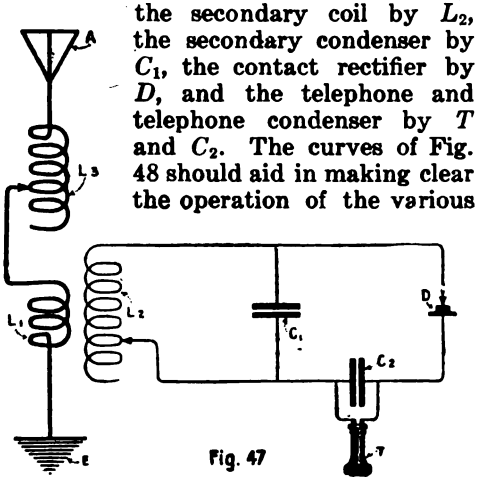

Fig. 47

A complete hookup for a wireless telegraph receiver with aerial circuit in two parts

What Happens in the Receiver

On the upper line of Fig. 48 are plotted three groups of radio frequency voltages such as are set up in the antenna and secondary circuit by any three successive groups of waves which strike the antenna wires. As previously explained, the radio waves passing by the receiving station create alternating voltage impulses in the aerial-to-ground circuit, these pulses setting up corresponding currents through the primary coil. The antenna circuit currents have the same frequency as the waves which induce them; thus, if a 600-meter wave is being received, the aerial current will flow at 500,000 cycles per second. By adjusting the inductance coils to suit the capacity of the antenna and the frequency of the induced currents, the largest possible current is built up by the process of tuning or resonance. This radio frequency alternating current flowing through the primary coil induces similar currents in the secondary, and impresses upon the secondary condenser, C_1, a series of groups of radio frequency potentials such as shown on the first line of Fig. 48.

As would be expected from a study of the wiring diagram, the potential of the condenser, C_1 will attempt to force a discharge current through the detector and telephone circuit at the right. This is where the peculiar feature of the detector, namely, that it passes current more easily in one direction than in the other, is of importance. If we assume the detector to be ideal in that it permits free passage of current in one direction and prohibits its passage in the other, we will find that the current through it corresponds to that shown on the second horizontal line of Fig. 48. Here it is seen that the positive (upward) voltage pulses result in positive currents of brief duration, but that the negative pulses do not force any current through. Thus a series of pulses in one direction is applied across the terminals of the telephone and the telephone condenser. Since the fine wire coil around

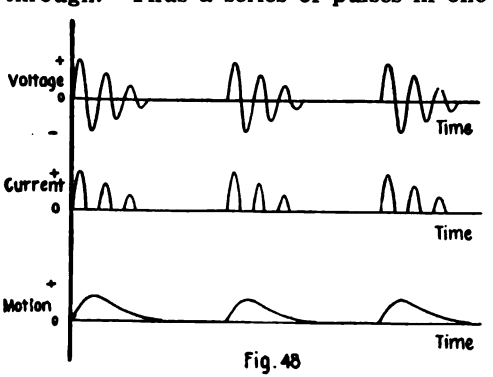

Fig. 48

In this is shown a series of groups of radio frequency potentials set up in the antenna

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the telephone magnet pole pieces has high inductance, and since the telephone condenser usually has a fairly large capacity, the group of pulses is smoothed out to some extent, and the movement of the telephone diaphragm is as indicated on the third line of the figure. We thus see that for each group of waves there is produced a single motion of the telephone diaphragm.

Effects of Spark Frequency

Let us consider the effect of spark frequency and regularity upon the sound of the radio signal produced in the receiving telephone. If the sparks in any signal group, dot or dash, occur at equal intervals the telephone diaphragm will be moved regularly, and consequently the sound produced will be musical

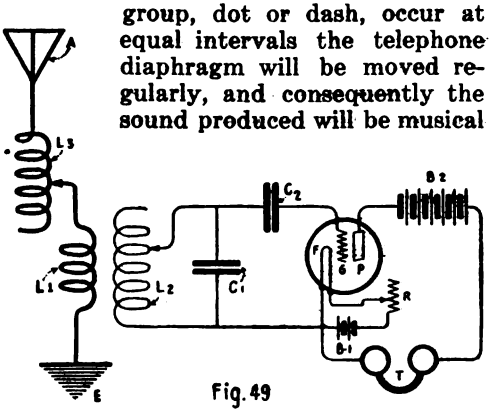

Fig. 49

The vacuum tube or audion detector has come into wide use since the beginning of the war

in character. The pitch of the tone will depend upon the spark frequency; if a spark transmitter having 120 cycle power supply is used, with one spark per half-cycle, 240 sparks per second will be produced and the signal tone will sound slightly lower than middle *C* on the musical scale (which is 256 vibrations per second). If a 500-cycle transmitter is used under the same conditions the sparks will occur at the rate of 1,000 per second, and the signal tone will have a pitch about two octaves higher. On the other hand, regardless of the number of sparks per second, if the sparks occur at irregular intervals in point of time the sounds will not be musical; it is well known as an elementary physical principle that noises are distinguished from musical tones by the lack of regularity in their component impulses, and the action of spark transmitters gives a splendid practical demonstration of this fundamental physical truth.

The skilful radio operator, then, will invariably do everything in his power to keep his transmitter spark regular in occurrence so as to produce at the receiver the clear musical tones which can be distinguished from the harsh noises of atmospheric disturbances. He will also prefer to use high spark frequencies, in the neighborhood of 1,000 per second, so that the musical tone will be not only clear but high pitched and thus still more easily copied in the presence of static and strays.

The Audion Detector

The crystal or contact rectifier is in extensive practical use as a radio detector, and its action must be understood by the war-time operator in either the land or sea service. Another important type of detector which has come into wide use, especially since the beginning of the war, is the vacuum tube or audion. This, in its most practical form, is indicated in Fig. 49. A small incandescent lamp, highly evacuated, contains, in addition to the usual filament, *F*, a wire grid, *G*, and a flat plate, *P*. Sometimes there are two grids and two plates connected together. The filament is lighted by means of a low voltage battery, B_1, and the brilliancy of incandescence is usually controlled by means of a resistance, *R*, in the filament circuit. The grid is connected to the secondary condenser by way of the condenser, C_2, of considerably smaller capacity than when the crystal detector is used; the other terminal of the secondary condenser, C_1, is connected to the filament. A third circuit from the filament to the plate contains another (and higher voltage) battery, B_2, in series with the telephone receiver, *T*.

This vacuum tube detector is considerably more sensitive than the best crystals, and consequently is especially valuable when long distances are to be covered or when feeble transmitters are to be used. The action is in many ways similar to the crystal rectifier, however, since the radio frequency alternating potentials applied to the grid are rectified perfectly so each current-group charges the grid to a higher-than-normal negative potential for a brief time. The effect of this increased negative charge is to reduce the battery current from B_2 flowing through the telephones, and consequently a movement

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of the telephone diaphragm is produced for each group of waves received. The particularly useful feature of the audion is that the change in the telephone current thus produced is considerably larger than the current which could be set up by the energy of the received waves alone; thus the audion actually amplifies or increases the signal which is received, and so its marvellous sensitiveness is accounted for.

It is not possible in the limited space allotted to a series of elementary articles of this kind to discuss in detail the many additional uses of the various forms of radio apparatus. To-day the spark system of radiotelegraphy is of tremendous importance, but equally or more necessary is the type of transmission which uses wireless waves produced in continuous or "undamped" streams instead of in groups. The student will find, however, that the fundamental principles of operating and manipulation which have been explained may be applied to any sort of radio apparatus; whether the circuits are simple or complex, or whether the waves are produced continuously or in spark-groups, the same general conceptions will prove helpful in analyzing the apparatus and learning its functions. The complete series, which is closed by this article, should give an adequate idea as to the main points with which one must be familiar in order to use radio apparatus successfully.

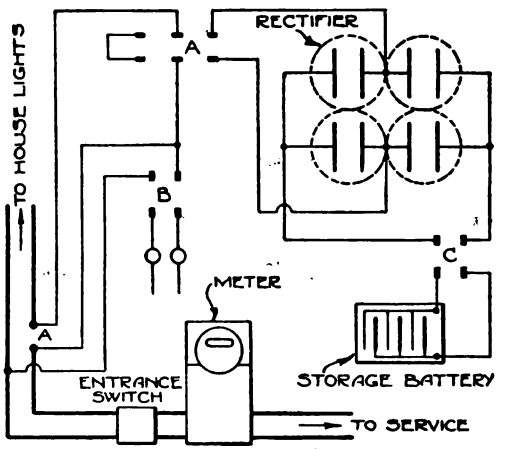
(*The End.*)

An Inexpensive Method of Charging Storage Batteries

THE usual practice in charging storage cells is to use some form of rectifier when the current at hand is A.C. To cut the voltage down a resistance or lamp bank is employed. With current selling at even nine cents a K.W. hour this is rather an expensive proposition, for a large part of the current is wasted in the lamp bank or resistance.

The writer has evolved a simple method of overcoming this defect and always keeping the batteries right up to the mark, the most interesting part being that it costs practically nothing to charge the cells.

The attached illustration will show how this is made possible. After the service wires have passed the entrance switch in the basement, one of them is cut and a lead from each side of the cut is carried to a blade of a D.P.D.T. switch. One set of clips on this switch are short-circuited and the other set are connected with the rectifier, an electrolytic being used in this case. A third wire is also



The connections with rectifier for charging storage cells from an alternating current

connected to take the current direct from the meter.

It will be apparent that when the switch *A* is thrown to the right all current used in the house must pass through the rectifier and storage battery; in other words, the house lights act as the lamp bank. There is of course a certain drop in voltage, but this is in nowise detrimental. When the charging is to be stopped for any reason the switch *A* can be thrown to the left, thus cutting out the rectifier.—THOMAS W. BENSON.

Cleaning the Surfaces of Celluloid Articles

CELLULOID articles can rarely be restored to their original whiteness if they have been thoroughly discolored throughout, but if merely superficially discolored, wipe them with a woolen rag wet with absolute alcohol and ether mixed in equal proportions. This dissolves and removes a minute layer of the surface being cleansed and lays bare a new surface. To restore the polish rub briskly with a woolen cloth and finish with silk or chamois. A bit of jeweler's rouge will greatly facilitate matters.

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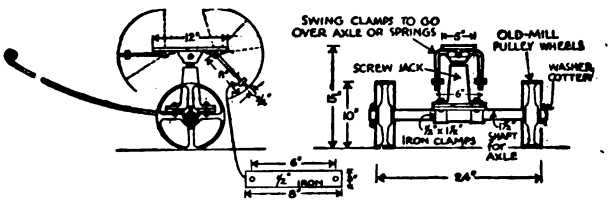
A Homemade Ambulance for Towing in an Automobile

IF an axle or wheel breaks on a pleasure car or truck the whole car may be easily hauled in by means of the ambulance illustrated. It is made from a large screw-jack, a length of 1½-in. shaft for the axle and two pulleys or belt wheels. The base of the jack is clamped to the axle in the center and the pulleys placed on the ends. A draw-bar or tongue is also fastened to the base of the screw-jack.



Dimensions of the parts for making a two-wheeled ambulance to tow in broken down automobiles

If it is the front axle that has been damaged, the ambulance is run under it and the jack raised to lift the automobile axle, after which the axle of the ambulance is supported by a rope run to some part on the rear axle to keep it from pulling out from beneath the car. If the rear axle is damaged, the ambulance is placed under it in the same way and the rope is run to some part of the axle on the front of the car.—P. P. AVERY.

A Way to Determine if Copper Is Used in Canned Goods

COPPER compounds are often used in canned goods, such as peas, beans, and spinach, to give additional depth to the green tint. Precautionary measures should be taken to detect the presence of these compounds. Vegetables suspected of containing copper should be mashed in a dish, a little muriatic acid added and the contents warmed. The residue is strained out through a fine cloth and thrown away. The resultant liquid is kept and ammonia water in excess of the acid is added to it. The presence of a deep blue coloration shows that the substance tested contains copper. This simple test will enable one to avoid copper poisoning.

Cleaning Dirt and Grease Marks from Tracings

TRACINGS may be very readily cleaned and pencil marks removed by the use of benzine, applied with a cotton swab. It may be rubbed freely over the surface without fear of injury to the lines drawn in ink, or even water colors, but pencil marks and dirt will quickly disappear. The benzine evaporates almost immediately, leaving the tracing unharmed. The surface, however, will be somewhat softened, and should be rubbed down with a little powdered talc or chalk, before drawing more ink lines.

Screening Gravel as It Is Loaded Into Dump Wagons

THE handling of gravel and passing it over screens for building highways added considerable cost to each yard of the material handled, but an ingenious screen invented by Donald A. Thomas, and adopted by the Michigan Highway Department, reduced this cost to one-half.

The screen used is 3 ft. wide, and the length of the dump wagon is usually about 9 ft. The frame is made of 2 by 4-in. stock with two cross-braces of the same material. It is covered with screen wire having ¼-in to ⅓-in. mesh, which gives a satisfactory product. The angle at which the screen is set can be varied to suit the material being dug. The lower edge of the screen is provided with hooks to hang on the side boards of the wagon, while the other side of the screen is supported by posts hinged on bolts to the edge of the frame.

A screen fastened to a wagon box onto which the gravel is thrown for screening out the smaller pebbles

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A New American Ball Game Using the Inflated Ball

THIS new game is called American Ball because it is adapted from and includes the best elements of the three great American games that are played with a large inflated ball,—college foot-ball, soccer foot-ball and basket-ball. Its rules are simple, its play varied, and its action vigorous.

The equipment consists of a ball—a soccer foot-ball is used—and an outdoor field, 100 by 200 ft.

The goals are a combination of those used in the three games: Uprights are erected 15 ft. apart at each end of the field. Two cross pieces are nailed horizontally to these uprights, one 8 ft. and the other 10 ft. from the ground, with an 18-in. space between them.

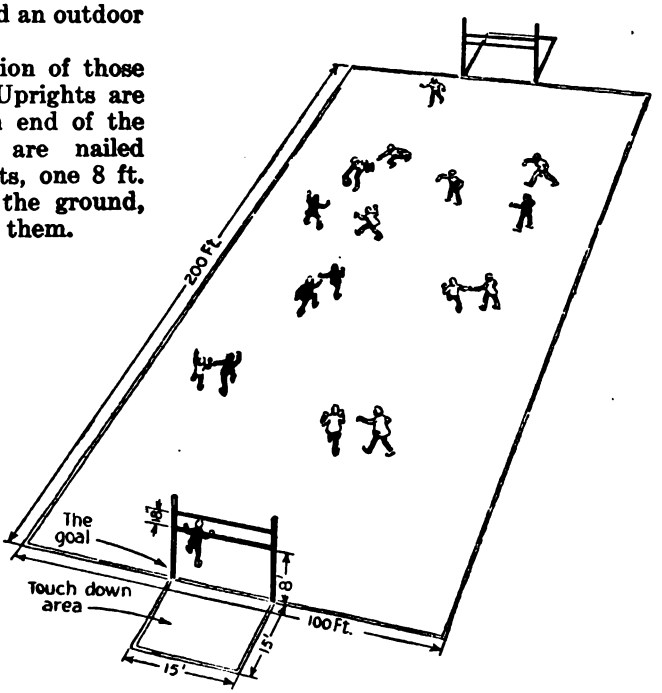
The touch-down area is a 15-ft. square marked on the ground just back of the goal posts. The teams consist of eight players — one goal keeper, two guards and five forwards.

The game shall consist of forty minutes' actual playing time, divided into ten minute quarters, with three minutes rest between quarters. One of the distinctive features of the game is that the ball may be advanced or played in any direction in almost any manner—by carrying, kicking, throwing, striking, or dribbling.

The side that wins the toss-up has the choice of goals or of putting the ball into play. At the beginning of each quarter, and after a goal is made, the ball is put in play at the center of the field in any of the following ways: (1) As in a foot-ball scrimmage, (2) by a soccer kick-off, (3) by a toss-up as in basket-ball, (4) by any kind of a throw or kick in any direction, (5) by running with the ball after the referee has blown the whistle to start the game.

The captain informs the referee which method of putting the ball into play he desires. The referee then announces it to the teams and gives them time to put their players in position. He then blows his whistle, after which the ball must be put into play within ten seconds, or be given to the other team to put into play.

The players must be "on sides" only if the foot-ball or the soccer style of play is chosen for the start. If a free place-kick is chosen, the opponents must not be nearer than five yards until the play begins. If a free throw or a run is chosen, the opponents may approach within 8 ft.



A ball game that is adapted from and includes the best elements of the three great American games played with the large inflated ball—college foot-ball, soccer foot-ball, and basket-ball

of the player with the ball. After a goal is made, the losers put the ball in play at the center. At the quarters, the teams alternate. A "down" is made when a player who has the ball (holds it in any manner) is touched by an opponent. The ball is then "dead" and goes to the opponents to be put in play on that spot. On a "down" the ball may be put in play by a free throw or kick in any direction within ten seconds after the referee blows his whistle, during which time the opponents may approach not nearer than 8 ft. to the player. The ball must not be put in play until the referee's whistle blows,

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which must not be until the opponents have had time to place their men to guard the play.

When the ball is out of bounds. When the ball goes or is carried across the side boundary lines it is given to the opponents to put in play at the spot where it crossed the line. This may be done by any kind of throw or kick in any direction into the field.

When the ball goes out of bounds across the end boundary lines at or near the goals, it shall be put in play at a point 25 ft. from the nearest goal post.

A "touch-down" is made when a player runs with the ball and without being touched, himself, touches the ball to the ground in the touch-down area. The ball may be carried out of bounds only on a manifest attempt to make a touch-down.

A goal is made by kicking the ball either over, under or between the goal cross pieces from the field, which scores two points. The side making a touch-down scores three points. Throwing the ball through the 18-in. opening means a gain of only two points.

A foul by an opponent or a touch-down by a player entitles a team to a free try for goal. The team may select either a free throw for the 18-in. space from a 20 ft. mark, or a free kick from the yard mark as in soccer or foot-ball. A goal from a free throw or kick scores one point. During a try from a free throw or kick all players except the guarding goal keeper must be back of the ball until the throw or kick is made.

A foul is made by excessive roughness, such as downing, tackling, tripping, striking, holding. The referee must decide. If fouls are extreme, the referee shall disqualify the offender.

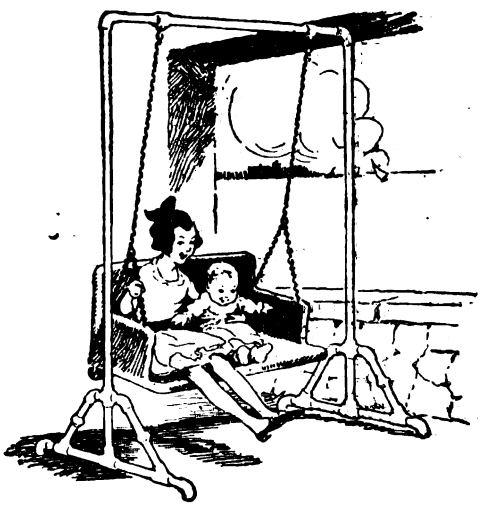
It will be noted that American ball allows a great deal of latitude and for that reason is a joy to both player and spectator. Most big games have too many restrictions.

American ball calls for quick judgment and action, and because there is little danger of accident, it does away with the objections found to so many of the other big games.

Since this game can be played equally well on skates, it makes a good winter sport and thus can be played in one form or other all the year round. When played on ice, it is well to waterproof the leather cover of the ball used. This game is very popular where it is now played.

A Porch-Swing Support Made of Pipe and Fittings

THE illustration shows the construction of a porch-swing support built by a gasfitter from materials he was proficient in handling; however, this material makes it quite convenient for



Pipe and fittings joined in such a way that it makes a substantial swing support

any person not so well informed on mechanics to put together after the parts are made ready by a local plumber.

Pipe ¾ or 1 in. in size is suitable. Dimensions can be adjusted to suit conditions. The whole affair can be dismantled by unscrewing the two unions in the lower braces. As the swing is hung near the uprights it will easily hold the weight of the occupants.—JAMES M. KANE.

Repairing a Speedometer Shaft With a Nail

FOR repairing the shafts of speedometers of the link type, I have found that a very satisfactory job can be made by taking a finishing nail of the proper length and size to suit the size of the speedometer shaft it is desired to repair, and by cutting off the point and head and bending to the proper link shape. This work can be quickly and conveniently done with a pair of wire cutters and a steel punch.—H. K. CAPPS.

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. . . and at all 6 stands in the Capitol building

A fact:

The 6 tobacco stands in the Capitol building at Washington are patronized mainly by the big business and professional men from all sections of the United States who are constantly coming into and passing out of Washington.

At each one of these stands more Fatimas are sold every day than any other cigarette, regardless of price — which seems to show that the preference for Fatima is really nation-wide.

LIGGETT & MYERS TOBACCO CO.

FATIMA

A Sensible Cigarette

Men who think straight and decide quickly like a cigarette that, besides pleasing their taste, leaves them feeling fit throughout the day.

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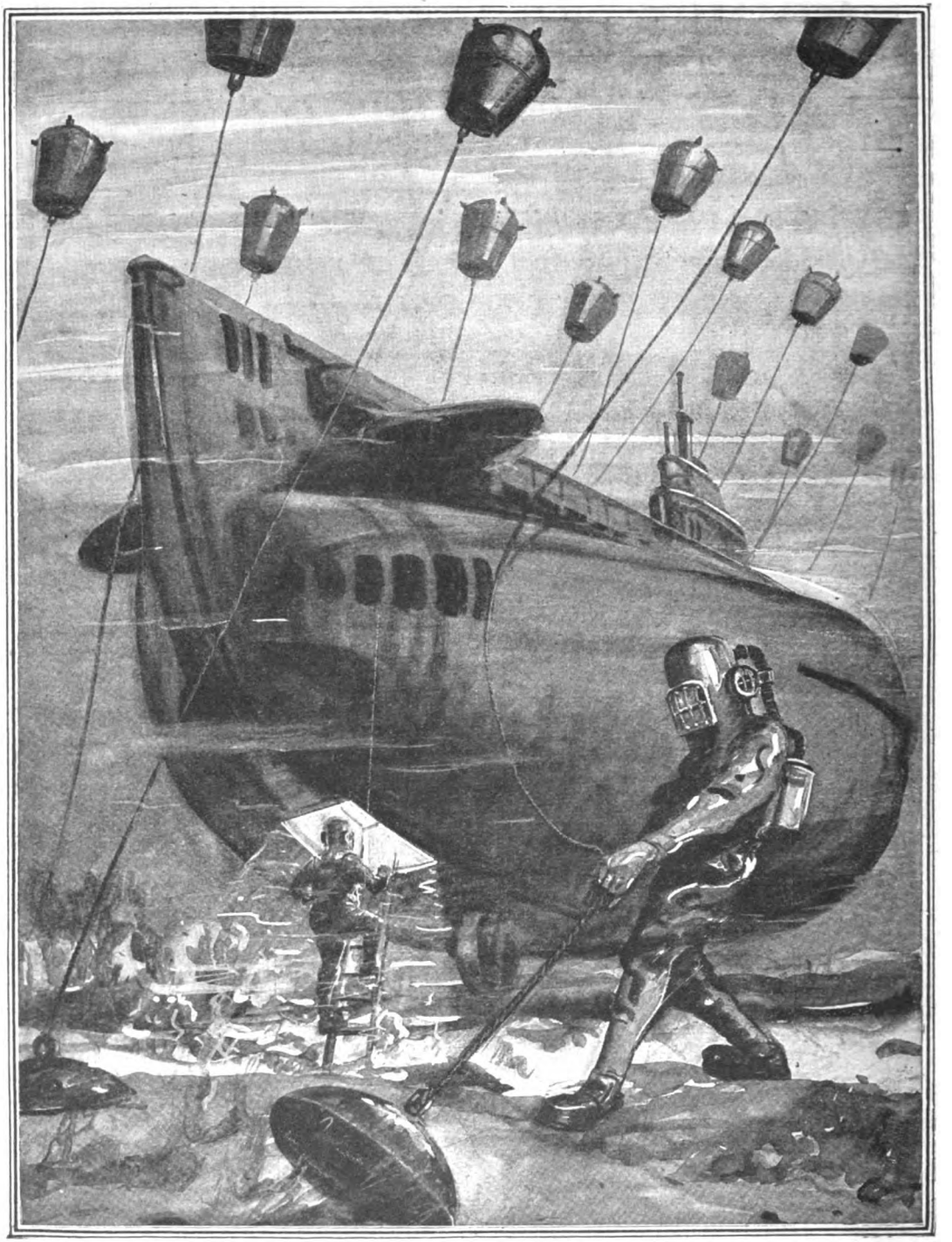
Creeping Through a Mine Field in Safety



The divers are clearing away the mines. They leave and enter the submarine by a door, just as they would a house. What keeps the water out of the boat? Just air, but at such a pressure that it pushes the water back. Wheels enable the boat to roll on the ocean bed

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Popular Science Monthly
225 West Thirty-ninth Street, New York City
Vol. 93 No. 3 September, 1918 $1.50 Annually

Now Comes the Sea Tank

Did the Italians blow up the Austrian dreadnought in Pola with an American wheeled submarine?

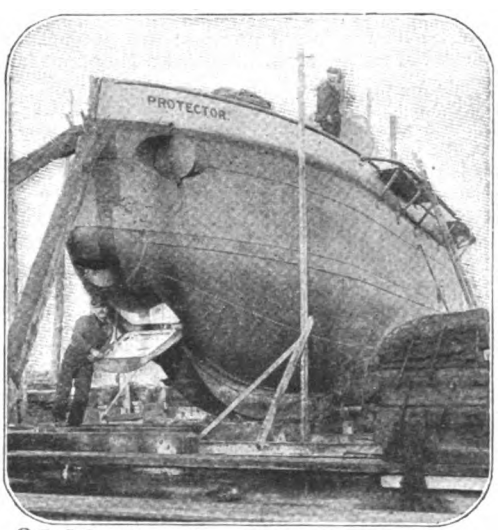
By Robert G. Skerrett

WHEN Lieutenant Commander Pellegrini forced his way into the harbor of Pola and sank at least one of Austria's biggest dreadnoughts, what sort of craft did he command? The dispatches say that he used a "sea tank," and that "the boat was forty feet long, six feet wide, and propelled by electricity. There is an endless rotary chain around the vessel fitted with barbs which cut nets and other obstacles, like the land tanks. The craft has two torpedo tubes."

These particulars may be correct, and, again, they may be nothing more than governmental camouflage to cover up the laxity at Pola, which permitted the Italians to get by the guardship at the harbor mouth, to thread a maze of cunningly-planted mines, and, finally, to break through an inner defense consisting of a barrier net of wire rope. But if Lieutenant Commander Pellegrini did use a so-called "sea tank," its success was spectacular, and the public, both lay and technical, is naturally curious to know what new order of torpedo-boat has been evolved for naval warfare.

A bit of hitherto unpublished history may help us to a fairly accurate idea of the real nature of the sea tank in question. As in the case of the land tank, we may find that the type is substantially a duplication of an American invention conceived primarily to facilitate commercial salvage operations under water. Pellegrini's sea tank was, in all likelihood, a modification of the wheeled submarine *Argonaut* built by Simon Lake in Baltimore in 1897.

The *Argonaut* was a stumpy cigar-shaped vessel of steel, thirty-six feet long, having a maximum diameter of nine feet. When fully submerged, her displacement was about fifty-nine tons. The boat was built to travel on the surface or to roll along on the oceanbed, and two big cog-rimmed driving wheels, driven by a gasoline motor through suitable gears, propelled her on the sea floor. By regulating the undersea craft's dead weight with water ballast the pressure or grip upon the bottom could be adjusted. The front compartment of the old *Argonaut* was a compressed air chamber or air lock that is used in tunneling beneath the rivers. The air in the chamber was compressed to such a degree that it



© R. G. Skerrett

This wheeled submarine of the Argonaut type was sold to Russia when at war with Japan

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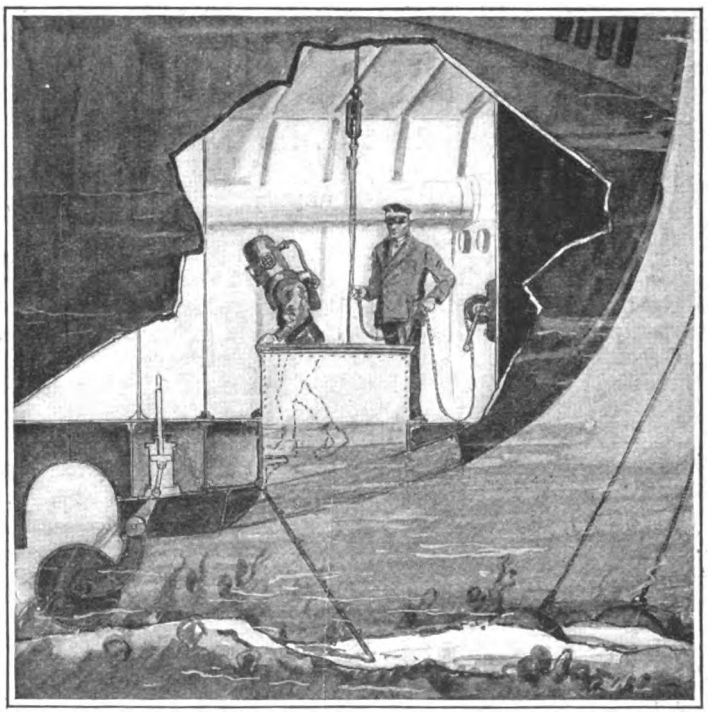
prevented the water from coming in through an open hatch while a diver could step from the chamber right out upon the bottom of the sea.

The purpose of the *Argonaut* was to make salvage operations safer and easier by furnishing the divers with a submerged base from which to work unhampered by weather conditions at the surface. The *Argonaut* cruised upon and below the waters of Chesapeake Bay in 1898 and also covered many hundred miles both under and above water. The following extract from the vessel's log, dated July 28 of that year, is very suggestive:



The air pressure on the inside prevents the water from entering the hold when the trap door on the bottom is opened for the diver

"We were desirous of making a search for the cables which connected with the mines guarding the entrance to the harbor at Hampton Roads, but could not obtain permission from the authorities, who were afraid we might accidentally sever them, which would, of course, make their entire system of defense useless."

However, Mr. Simon Lake had a cable laid upon the bottom at another point, and then approached it from a distance after taking his bearings by compass. The *Argonaut* rolled along with the door of the diving compartment open, and succeeded without any trouble whatever in hooking up the cable and bringing it into the chamber, where it was cut to complete the demonstration.

Early in 1906, Mr. Lake was in Europe, and went to Rome to interest the Italian Ministry of Marine in his naval submarines which he had developed after building the *Argonaut*. Mr. Lake laid much emphasis upon the distinctive features of his type embodied in the diving compartment and his improved form of bottom wheels. The Minister of Marine listened for a while and then suavely said to Mr. Lake:

"But, my dear sir, our shores dip too quickly and suddenly to great depths to make these wheels of value in defending our seacoasts."

Mr. Lake promptly rejoined: "Yes, that is quite true, Your Excellency, with the exception of the Adriatic seaboard which lies nearest to your likeliest foe, Austria. From Ancona northward and then eastward to the neighborhood of Pola the 120-foot depth line extends off shore anywhere from five miles to many times that distance, and that sandy sea-bed is just the area within which a submarine with bottom wheels could do its best work in protecting the Gulf of Venice from a hostile naval force."

Can it be that the Italians borrowed Mr. Lake's suggestion? This ingenious American has shown more than once how a couple of his submarines could sweep mine fields with little fear of detection. Divers could cut nets easily without disturbing in the least the supporting surface buoys that might otherwise betray the presence of the attacking submarine.

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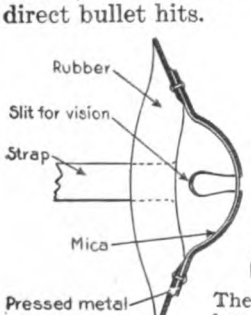
How France Protects Her Soldiers' Eyes

FOUR-FIFTHS of the cases in which soldiers sustain serious injuries of their eyes can be avoided, according to the statistics collected by Professor Terrien, an eminent French eye specialist. Only in one out of every five cases the injury produced by bullets, shrapnel, or splinters of bombs or shells is of such nature that it could not have been prevented by any ordinary safeguard.

To protect the eyes of the soldiers against avoidable injuries Professor Terrien and Major M. E. Cousin devised goggles, of which more than 10,000 have been distributed among the French troops on the West front and used with satisfactory result. The goggles, which are pressed from a single plate of metal one millimeter in thickness (about 39/1000 of an inch), are shaped to cover both eyes. The lower rim rests upon the lower arch of the eye cavity, the upper edge fits against the brow, and the middle parts are shaped to conform to the convex curve of the eyeballs. The brim of the goggles is covered with rubber to make them fit tight enough to protect the eyes against tear-producing gases. Cuts in the form of crosses, somewhat wider at the ends of the arms than at the point of intersection, enable the wearer of the goggles to see, while at the same time his eyes are protected from shell splinters. For additional protection the cross-shaped slits are covered on the inside by plates of mica.

These eye-shields are not, of course, intended to withstand direct bullet hits.



These goggles do not shield the eyes against bullets, but they do prevent injuries from stray shell splinters

If you don't have an opportunity to go to the links and practise putting, try this device

Golfers! Here's a Way to Practise Putting Indoors

A PUTTING disk has been invented for practising golf indoors and also for playing a game, which consists in driving a golf ball into a trap with the least number of strokes. A ball struck with enough force to knock over or upset the disk does not count. When the ball is driven so that it is held in the disk, the shot counts. The ball can be removed by raising the disk. The putter and golf ball ordinarily employed on the links can be used. The disk (four and one-half inches in diameter) is collapsible, so that it can be carried in a box one-fourth of an inch in height.

A Magnet for Removing Metal Chips

A MAGNET taken out of an old house telephone can be used for removing metal chips made in drilling. If the magnet is too large to go into the hole it can be placed in contact with a small rod as an extension. Several magnets tied together will recover tools dropped down an open partition. Drop the magnets down by means of a string.

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The "Harpitar," a Cross Between the Guitar and the Harp

"HOW can I improve the sound of the guitar?" asked Mr. R. E. Bates of Brooklyn, N. Y., speaking to himself of course, after the manner of inventors. Then he answered the question by thrumming the "harpitar," an instrument in which he has combined harp and guitar. Listen now to Mr. Bates' exposition of his invention:

"It combines the simple chromatic scale of the guitar with the peculiarly beautiful tones of the harp. When placed upon the lap the body of the instrument rests against the performer, the edge of the soundboard forming a rest for the wrist of the right hand so as to allow the hand freedom for attacking the strings.

Looks like a harp—strung like a guitar. No wonder its inventor calls it the "Harpitar"

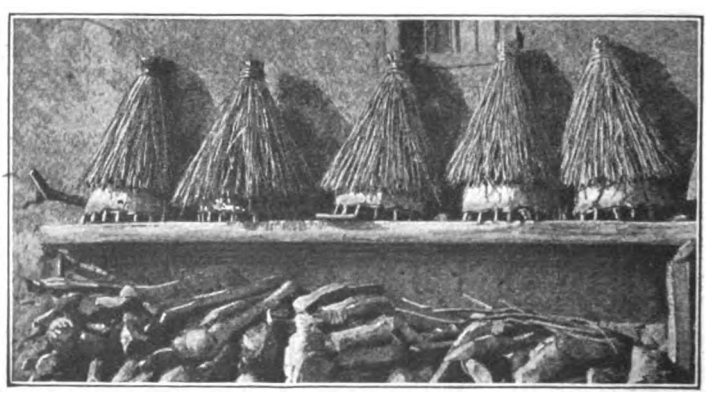
"The present-day guitar is a sweet-toned instrument, but it lacks projecting power, an inherent defect due to its general structure and to the manner of securing the strings over the soundboard. The pressure of the strings is but a fraction of the string tension. In the harpitar the whole tension of the string is fully exerted upon the soundboard. Hence thicker strings can be used and hence a greater volume of tone secured. The harpitar has six strings, like the guitar; a harp, twenty-six in the smallest size. Hence the harpitar is a money-saving instrument. In the harp the strings are distributed over the entire length of the sound-board. Since the greatest volume of tone is obtained at the center, the strings nearer the ends emit less mellow notes. But there can be no difference in volume because the six strings are all located at the center. The sound-hole is placed at the back of the body. Indeed, the bottom of the body is entirely open so that the sound waves well forth freely."

Though not musical, still we can appreciate the economy of having a two-in-one instrument.

Bee Culture in Macedonia Is Primitive

MACEDONIA, one of the most turbulent sections in the Balkan states, from which many a cry has startled a suffering world, does not seem to have progressed a great deal in civilization since the days of the great Alexander. Life in Macedonia is conducted on the most primitive lines, and the same is true of agriculture, the various trades, commerce and the methods of transportation. Ox-carts are still in common use; and the beehives, which are never lacking even at the poorest farmhouse, are of the same primitive form that were in use two thousand and more years ago. The picture shows a row of these beehives, placed on a shelf along the outside wall of the farmhouse. Below them the firewood is stored.

The hives are made of bark, supported by a framework of twigs and covered with straw roofs.



Two thousand years ago they used beehives just like these in Greece. The beehives are built on a shelf

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For the Man Who Goes Off and Forgets to Water the Geraniums

LEONARD I. LELIEVRE must have studied the kerosene lamp before he evolved the flower-pot for which the United States Government recently granted him a patent. If, he reasoned, oil can be soaked up by a wick and a lamp kept burning, why shouldn't a wick keep the earth in a flower-pot moist?

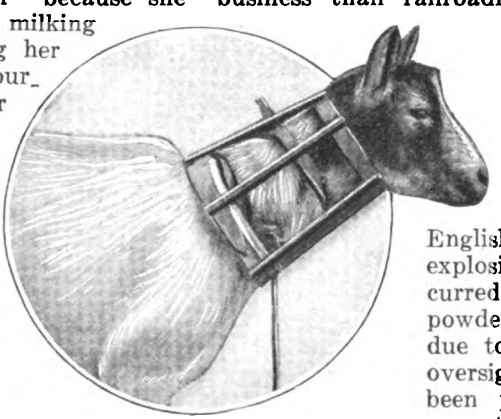
At all events, Lelievre embodied the wick idea in a flower-pot which commends itself at sight to the man who always forgets to water his geraniums. The flower-pot has a false bottom which is filled with water. A wick runs up from the false bottom to a pad of felt on which the earth rests. A metal disk on top of the felt pad prevents the roots of the plant from working their way down into the wick opening. It is needless to say the false bottoms must be kept full of water.

The plant waters itself by means of a saturated wick

Restricting Nanny's Milk Diet by Making Her Wear a "Choker"

THE goat in the accompanying picture does not affect the latest style of fashion in goat-collars. Neither does she wear the crate around her neck because of a sore throat or other ailment. Nanny has to wear this "choker" because she had acquired the habit of milking herself and thus robbing her young of the necessary nourishment. With this collar on, Nanny cannot reach the milk supply upon which her kids have a just and prior claim.

The collar consists of two or three rings connected by strips of wood. The lowest ring is wide enough to rest upon the shoulders and the top ring is tight to prevent its slipping over the head of the goat.



Nanny with the crated neck had the naughty habit of drinking her own milk

Manufacturing Explosives Can Be Made Safer than Railroading

DR. W. G. HUDSON, chairman of the Subcommittee on Industrial Diseases and Poisons, Council of National Defense, says that the automatic machinery which will replace human labor is of far more importance to the manufacture of explosives than the reduction of labor costs brought about by such substitution. Machinery of this kind is employed to a considerable extent by all large manufacturers of explosives in the Unites States, most of it having been invented by the employees themselves. Some of these machines, when operated by one or two men, accomplish as much as twenty or thirty workmen could do by older methods.

Dr. Hudson points out that the prime advantage of the machines is to reduce the number of employees in such hazardous work, thereby lessening the risk to human life. He says, however, that the popular conception of the peril involved in the manufacture of dynamite, smokeless powder, guncotton and trinitrotoluol is greatly exaggerated. If they were made by skilled chemists under the best of laboratory conditions, there would seldom be accidents, as "making explosives is a safer business than railroading." But it is difficult to guard against carelessness or negligence, many of the men being unskilled and having no speaking knowledge of English. Many of the explosions that have occurred in munition and powder factories were due to carelessness or oversight, though it has been proved in some cases that they were of enemy origin.

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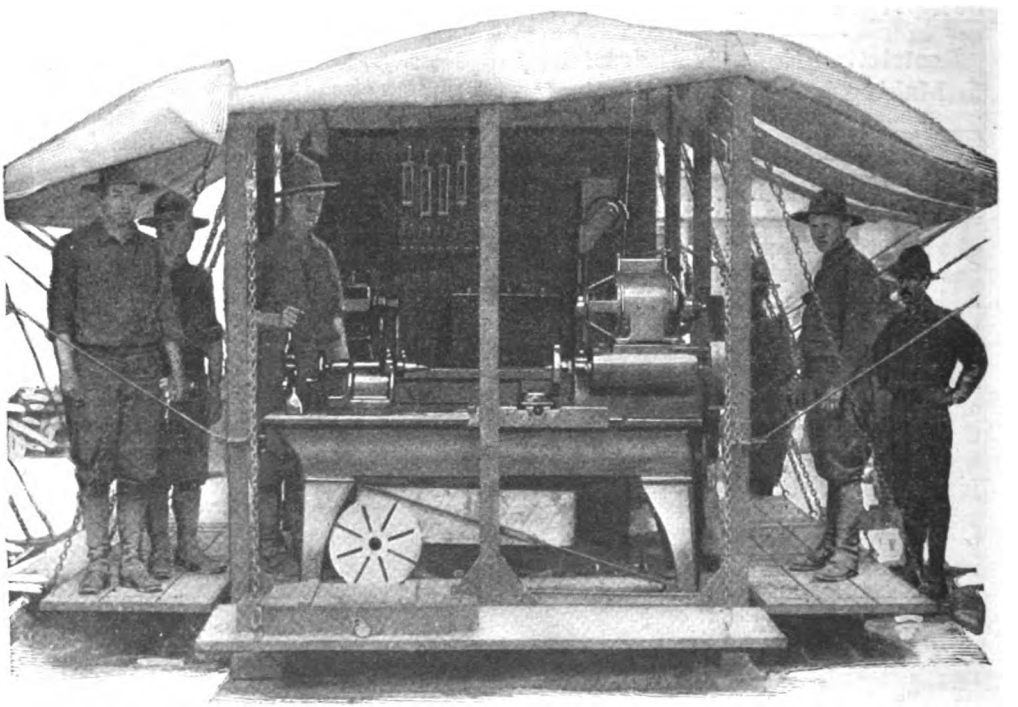
They build a combat railway just to learn how they are to do it in France. Its rolling stock consists of fourteen gasoline locomotive engines and more than one hundred cars



Machine tools are as necessary as bullets in this war of machinery. And so some of the men must learn how to run lathes and drills in collapsible machine shops

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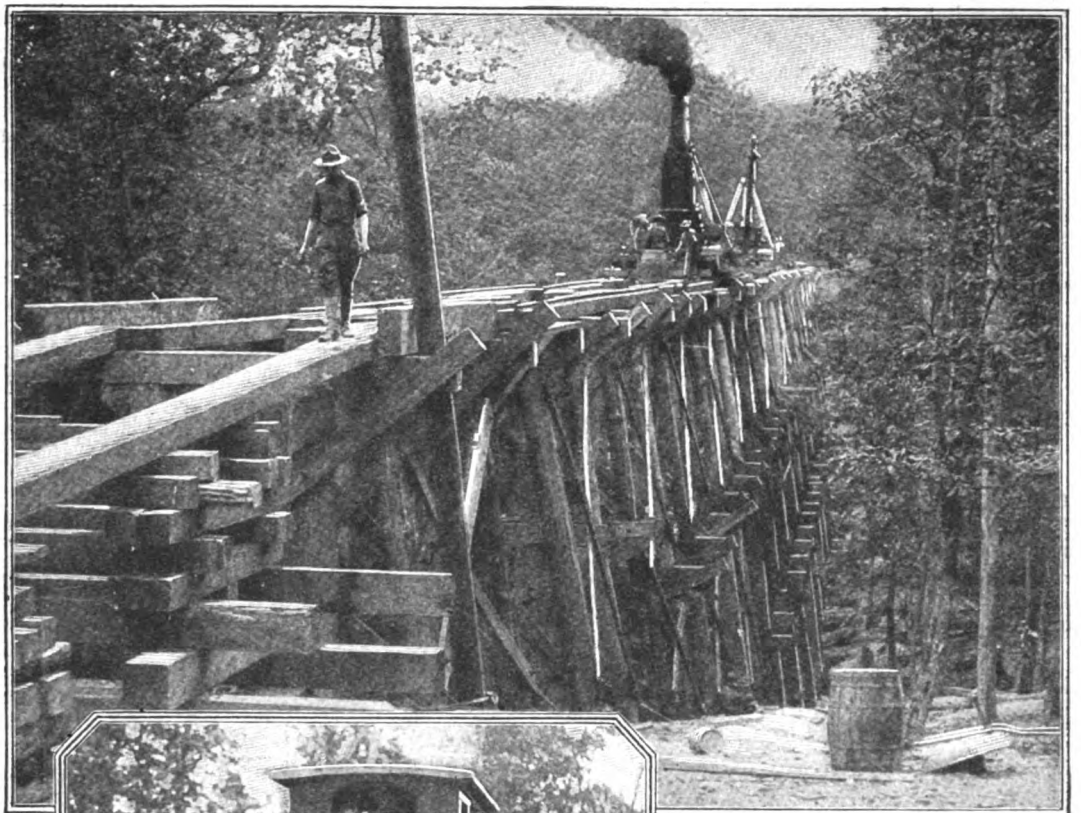
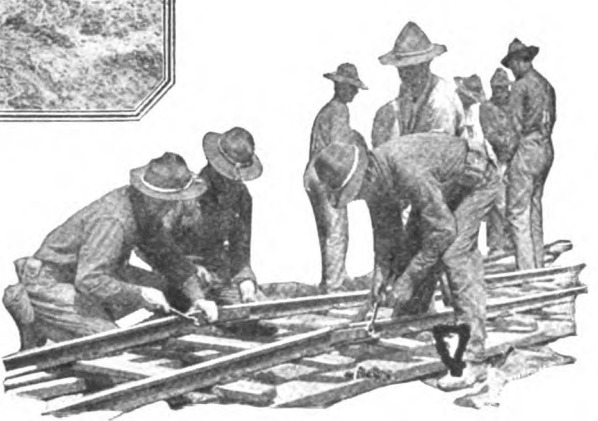
Who Are to Back Up the Army in France



Think of building such a trestle just for practice! It's part of the educational combat railway at Camp Humphreys, Va., which is located near the Potomac River

They will pull up stumps in France with traction engines, just as they are learning to do the trick at Camp Humphreys



Right: Yes, they teach them how to lay tracks, since many big guns are mounted on railway trucks on the West front

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Trampling Out the Rice That Feeds Them

It's footwork that threshes rice in the Philippines. The laborers stand in a row and stamp the rice on the mat with their bare feet

He takes a bundle of rice, holds it in two sticks, and pounds out the grains of rice on a large stone

More footwork. The threshed rice falls through the meshes of the matting on the raised platform

Even the caribous trample out the rice. Evidently the Filipinos get tired doing it with their own hands and feet

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Mr. Hoover, Please Take Notice

To the right: No bread in the garbage pail of New York's poor. They buy their bread by the slice, and eat every crumb. The foreign-born set an example to native Americans

Below: Inspectors found $20 worth of good food in the garbage containers of 163 New York families—bread, meat and vegetables. And this during wartime! Other cities are equally as bad

The Food Inspector

Above: Nine dollars' worth of good meat and fish was thrown away in one square block in Manhattan in a day. Did we hear somebody say "Food will win the war"?

Note the inspector in center picture. He took from four garbage cans 6½ lbs. of meat and the bread in the bag with 2 lbs. of boiled potatoes shown on the plate

In bread alone New York wastes 60,000,000 pounds in a year, and other cities are no better. We'll wager our best silk hat against a doughnut that Berlin has no such record

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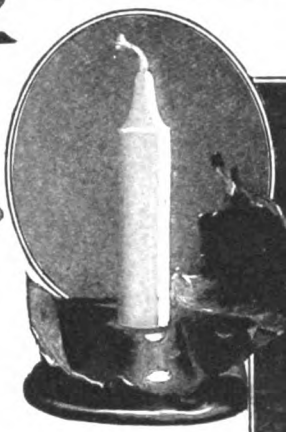
They Used to Plowshares. But Here Is What

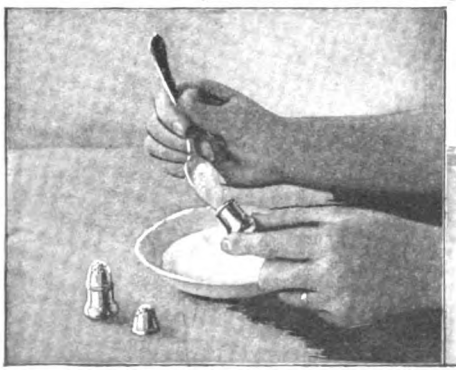
To the left—Ella Wheeler Wilcox ought to write a poem about the roses in the shell case. We can't

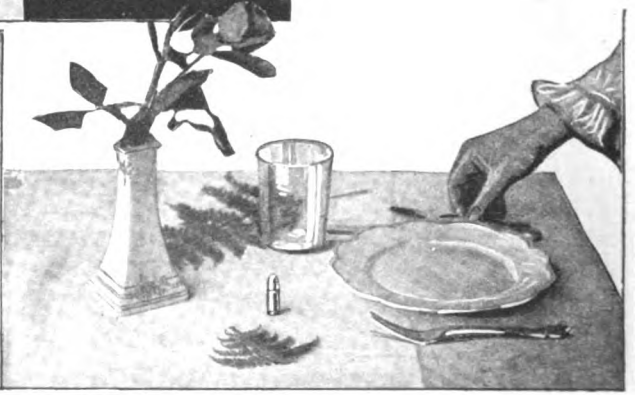
Below—The souvenir collector lucky enough to get possession of a piece of shrapnel converts it into a candlestick holder



To the right—Well, well, we never thought they would play dice with bullets. Still, we've known 'em to play poker with matches for chips

To the left—We hope the bullet conveyed a message to the Kaiser before the cartridge case was turned into a pencil and eraser





They even use cartridge cases as salt and pepper shakers. The shakers are finished with silver and take a high polish; the tops screw off in regulation fashion to permit refilling

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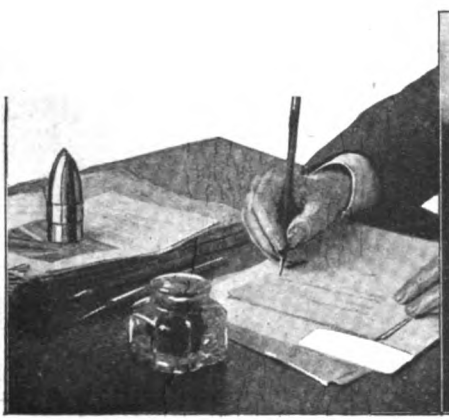
Beat Swords into Shells and Bullets—We Do to Them

To the right—Listen to "Over There" played on the bullet bazoo

Below—We'd like to pin one on the German Crown Prince but not exactly in the same way

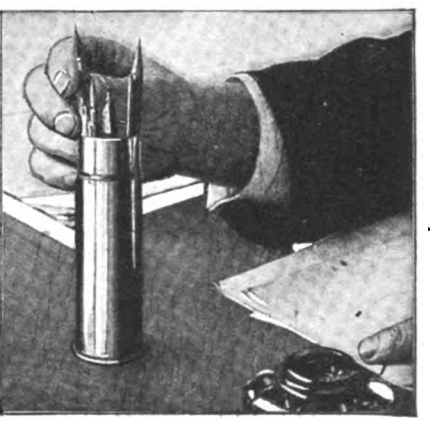
Behold the corporation president! His electric office lamp is a real three-inch shrapnel shell case, rejected because of imperfections. Note the detail of the lamp in the circle. The **shade is combined with Old Glory**

Our esteemed contemporary, Wilhelm von Hohenzollern, has no objection to our making **lamps out of shell cases**



A chance to moralize on the degradation of the noble bullet

Should be in a soldier's pistol



Many shell cases are rejected by the inspectors. Use one this way

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Butterflies That Go South Every Autumn

By courtesy of Am. Mus. Natural History

Butterflies migrate as birds do. Thousands of the American monarch butterflies gather annually on the branches of certain trees as though by appointment and their color blends so perfectly with the brown leaves as to be indistinguishable from the foliage of autumn

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Not Monks, But Camouflaged Artillerymen

The object of camouflage is to deceive the enemy, and the method employed for that purpose necessarily depends upon the conditions and circumstances in each individual case. No hard and fast rules can be laid down and the success of the camouflage depends upon the skill and imaginative power of the officers or men attempting it. The group in the picture with the anti-aircraft gun may not appear sufficiently disguised to deceive a reader, but it is safe to say that, to an observer in an airplane, the group appeared like lichen-covered rocks around a tree-stump

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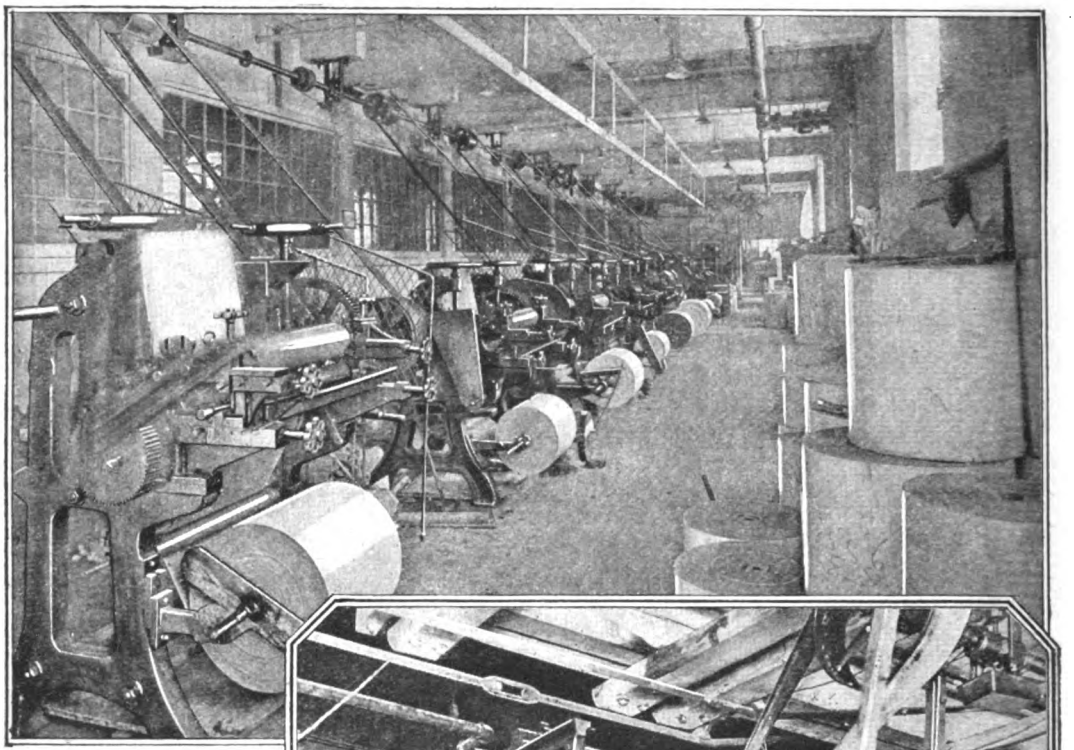
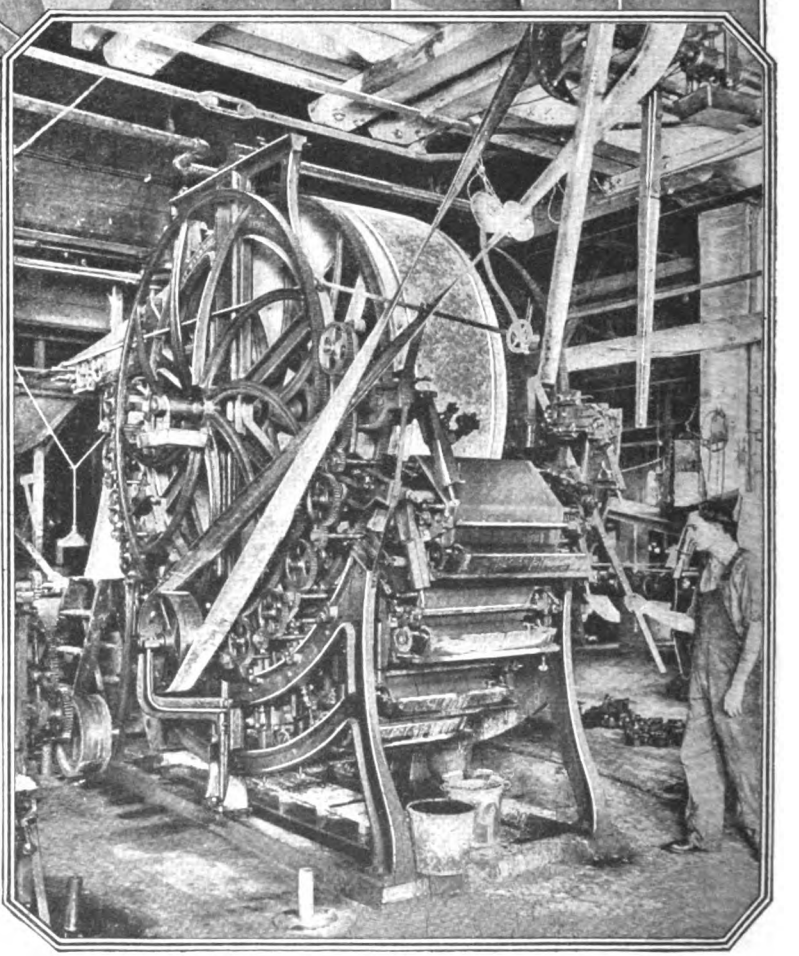
Miles and Miles of Printed Birds, Flowers,



Wallpaper is printed on presses that are not very different from other presses. The paper is fed in a continuous roll One color is printed at a time, the superposed colors (as many as fifteen are employed) reproducing the effect of the design made by the artist. The basis of the colors used is a fine white clay tinted with aniline and other harmless dyes



To obtain the effect of a woven fabric, grained leather, or brush-stippling, etc., the paper is often embossed. The paper passes under a steel roller or drum which has been engraved so as to press the desired design into the surface of the wallpaper

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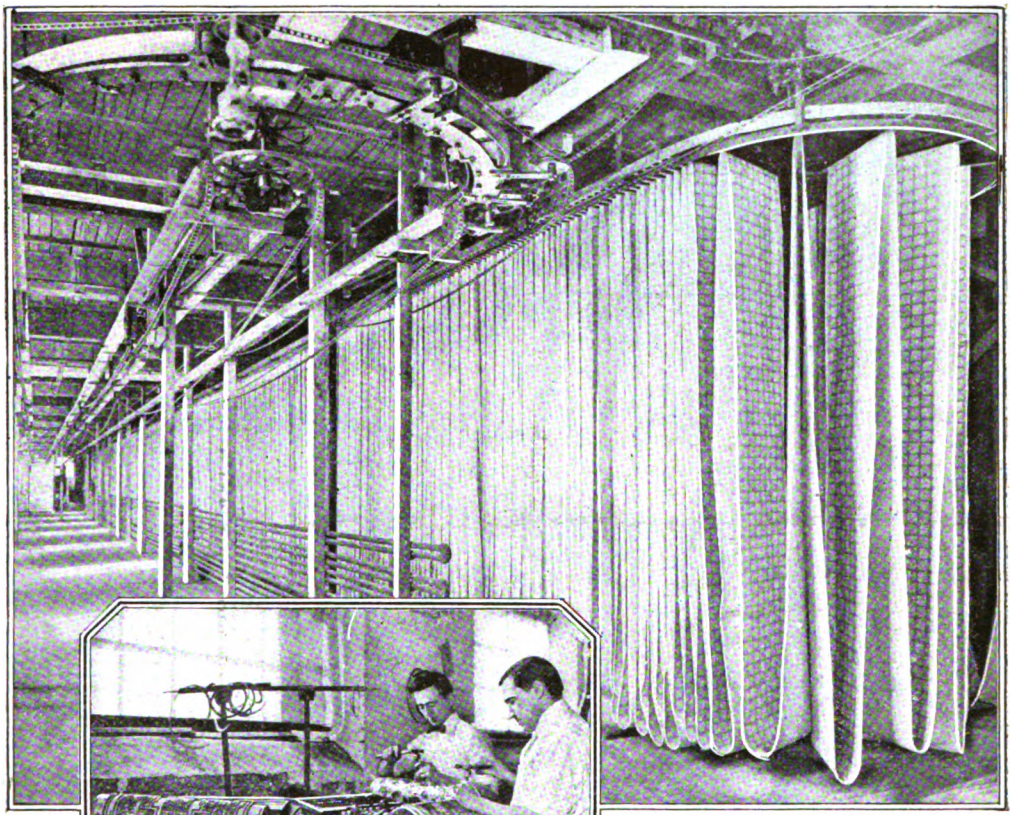
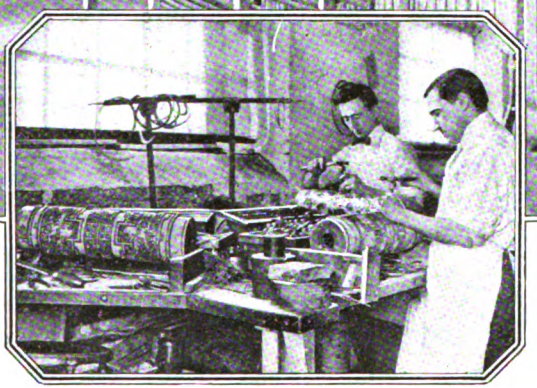
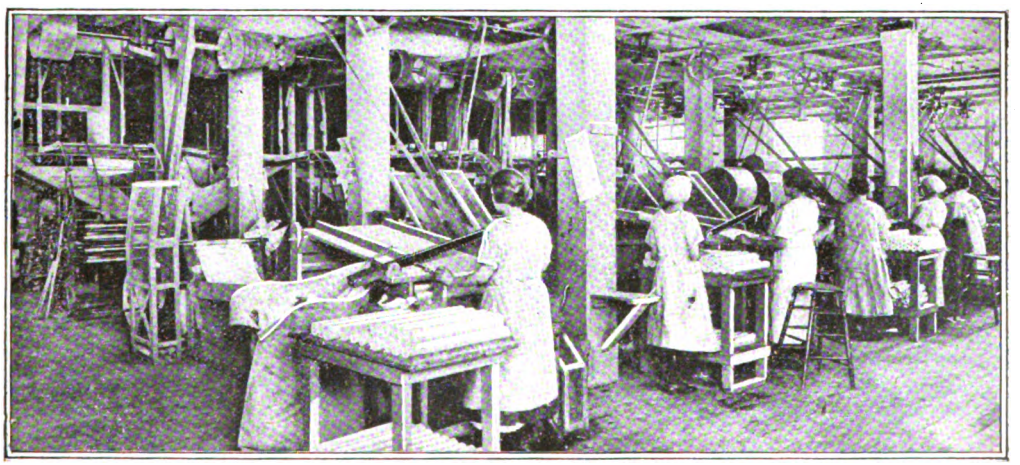
Stripes and Animals for the Nation's Walls





Miles of printed wallpaper hang in loops from a conveyer which carries it majestically to the drying-room

Left: The printing rollers are made by driving into a wooden drum bits of brass which form the design



The printed paper is fed in a wooden trough and is mechanically wound up by each girl on a rapidly revolving steel rod. When the girl sees a mark in the margin she stops the rolling machine and cuts the paper off. Then she has one of the rolls that you buy

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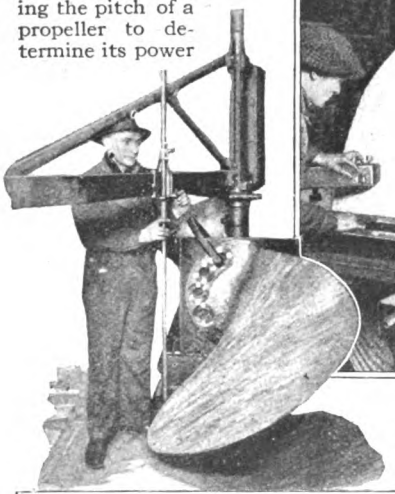
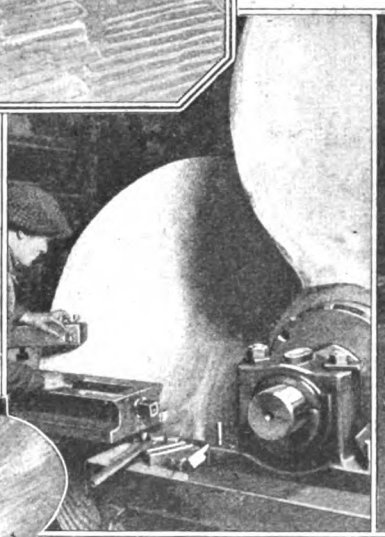
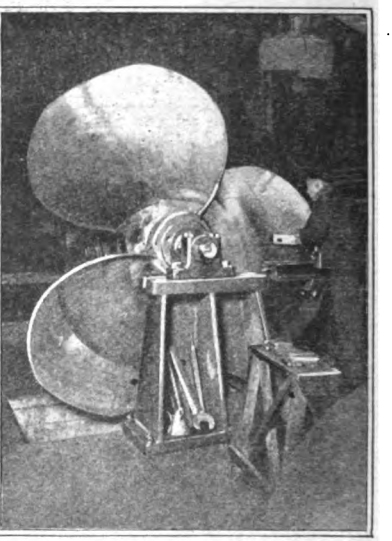
Out of Sight Usually Is But It Is Too Important

To the left: A ship's propeller must be shaped as carefully as a violin. Old Bill, here, is chipping off excess metal with a pneumatic chisel. But how does he know to what depth he must cut? See the figures in the squares? They tell him how much to cut

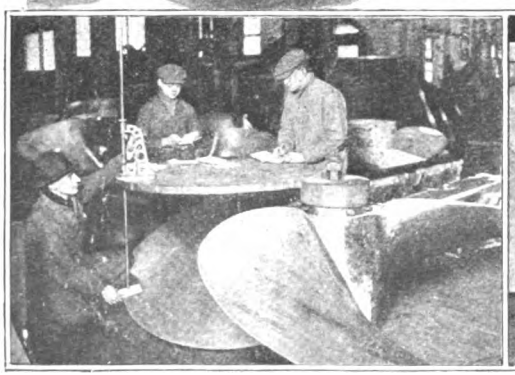
Below: Measuring the pitch of a propeller to determine its power



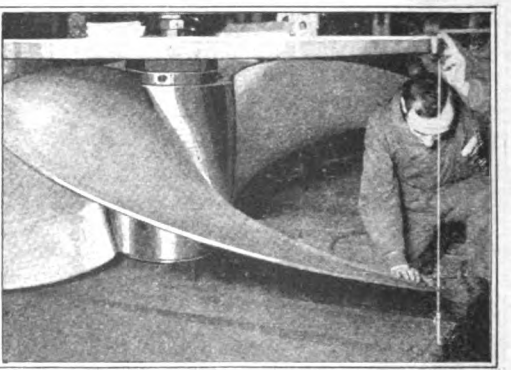




To the right the machine which smooths the blades; to the left a "close-up," as they say in the moving picture studios, of the machine's business end. In this manner the propeller blades are given an absolutely true screw surface by the machine



If the point of the rod doesn't catch the bit of paper held on the blade the pitch is wrong and somebody will soon hear from it



Each blade is part of a screw. Its pitch is the distance through which it screws itself in one revolution. Pitch means pulling power

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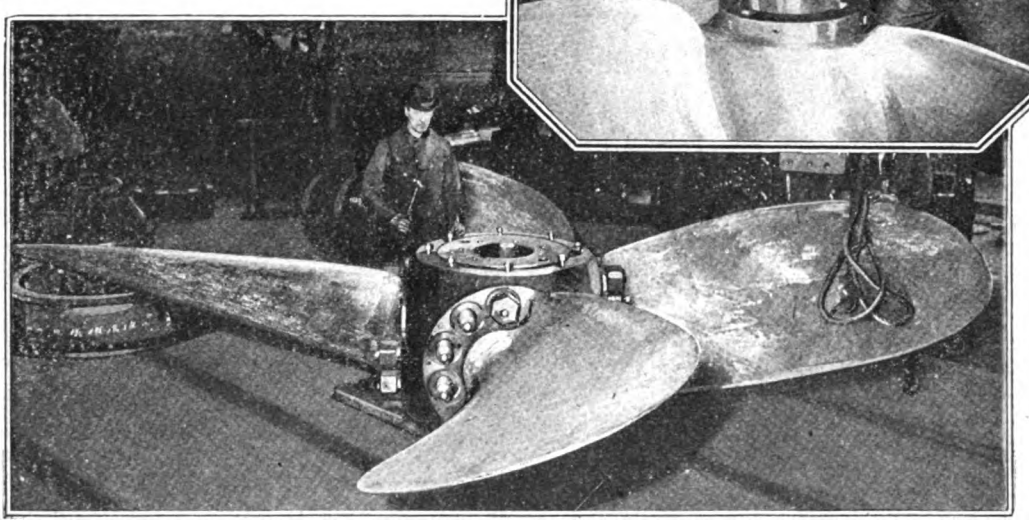
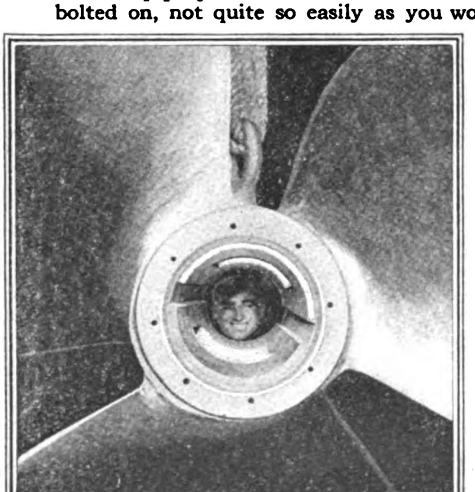
Every Ship's Propeller; Ever to be Out of Mind

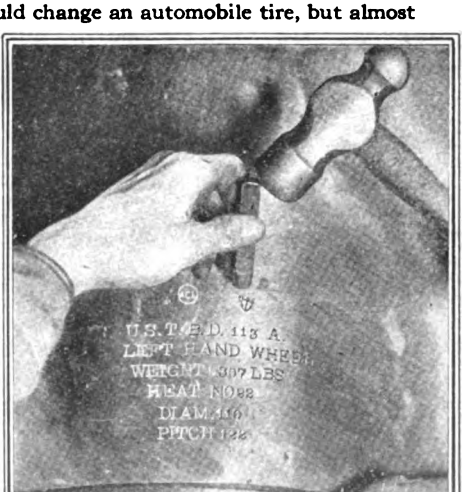
The cone is called a fairweather because it makes fairweather for the propeller by keeping the water from forming little whirlpools behind the "boss" or hub. Such whirlpools are as bad for the propeller as for a swimmer



Most ship propellers have four detachable blades. If a blade is lost another can be bolted on, not quite so easily as you would change an automobile tire, but almost



The hub of a propeller is tapered and wedged on the shaft by means of keys that fit in the slots. The size of this shaft is indicated by the man's head, which it sets off like a frame



Not until the government inspector stamps it with the Government's official acceptance stamp, having an anchor as a device, is the propeller permitted to be fitted to its shaft

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How They Wore 'Em Away Back in the Fifties

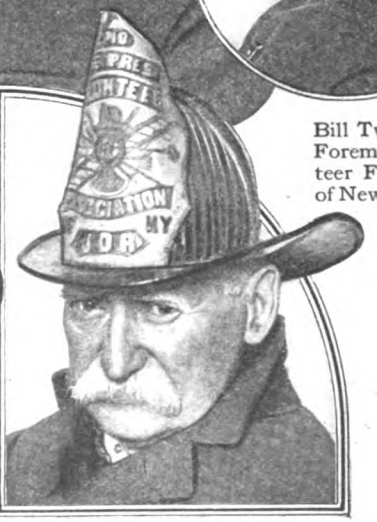
This is the hat James F. Wenman, ninety-four, wears on Washington's birthday. His father, Uzziah sported it as foreman of Franklin Engine No. 39 in 1818

Worn in 1858 by a member of Warren Hose Company No. 33 of Philadelphia

It came from Paris. In 1835 it was presented to Hook and Ladder 11 of New York

Harry Howard, Chief Engineer of the New York Fire Department, wore it as far back as 1834

Bill Tweed's. Bill was Foreman of the Volunteer Fire Department of New York. It dates back to 1851



James T. Watkins, aged 88 years, wears this hat once a year when the New York Exempts parade

The fire helmet the Volunteers of New York's Fire Department wore away back in the days of '58

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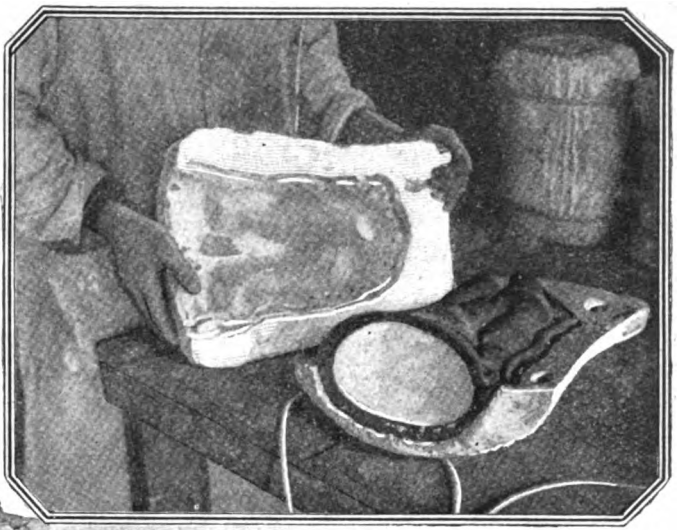
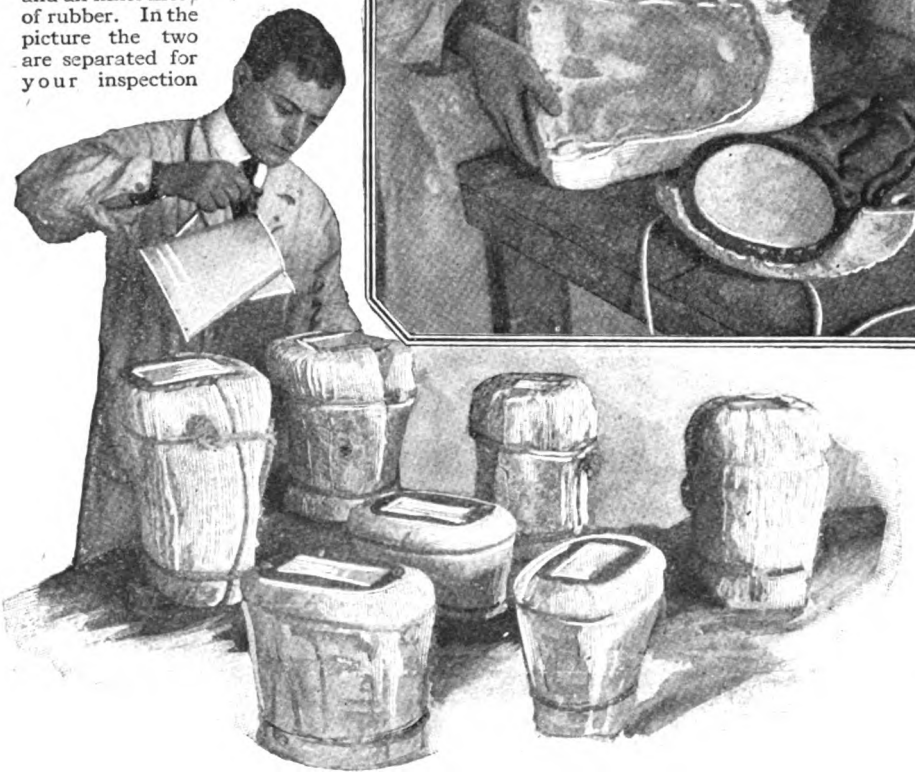
The Ford Idea Applied to Art

Right: Here we take you aside and show you how the marble statuettes that you buy on some street corner are made. They are cast—not carved. The mold comprises two parts—an outer casing of plaster-of-paris and an inner mold of rubber. In the picture the two are separated for your inspection





What's in the pitcher? A solution composed chiefly of marble dust—mere waste. Giuseppe, here, pours the solution into the molds like so much water. What happens then? See the pictures below

Giuseppe pulls the rubber mold away when the solution hardens. Behold the famous group!

Now come the scraping and the polishing, and the result is a finished work of art

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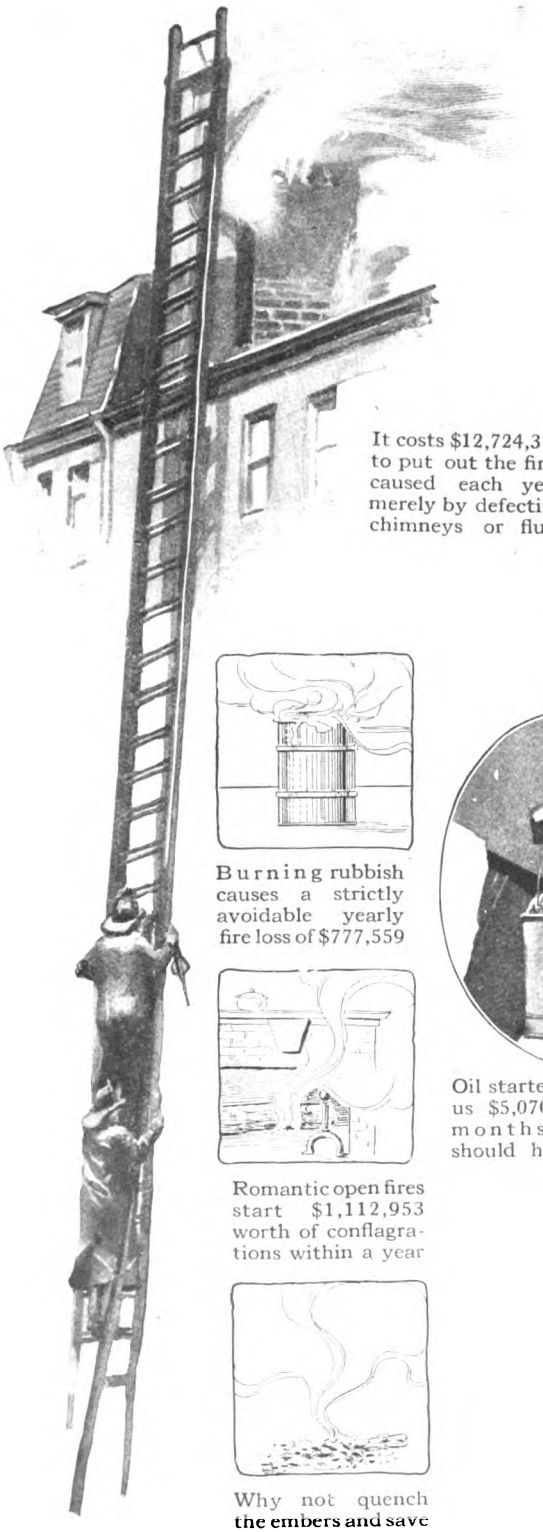
Every Year One Hundred and Sixty Million Dollars



It costs $12,724,317 to put out the fires caused each year merely by defective chimneys or flues

Picturesque and romantic—yes. But is it worth to put out partly preventable fires and $60,466,054 preventable fires? That's what our clanging

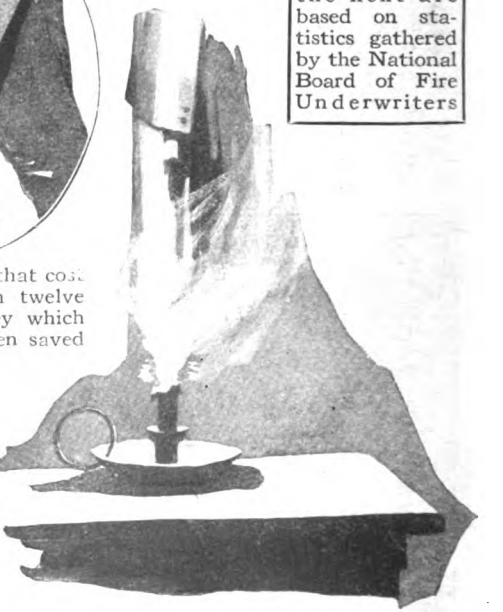
Burning rubbish causes a strictly avoidable yearly fire loss of $777,559

Oil started fires that cost us $5,070,100 in twelve months—money which should have been saved

The pictures on this page and the next are based on statistics gathered by the National Board of Fire Underwriters

Romantic open fires start $1,112,953 worth of conflagrations within a year

Why not quench the embers and save **$1,140,194 a year?**



Would you do this? Others have done it. The result? Annual fires costing $2,142,958. The Actuarial Bureau of the Board of Fire Underwriters receive **2500 insurance claim reports every day**

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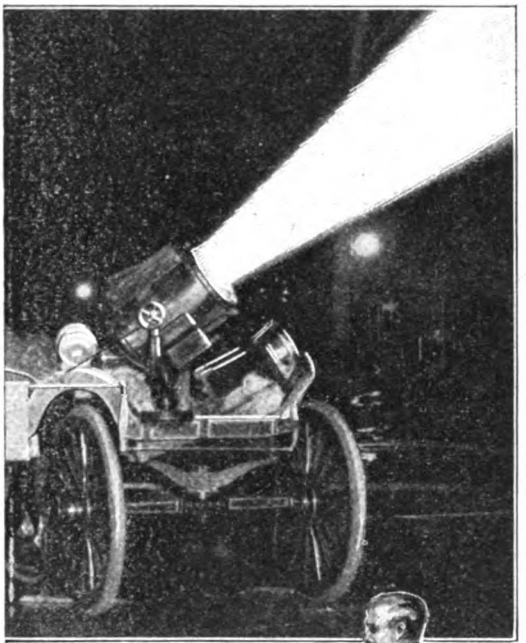
Goes Up in Smoke—All a Preventable Loss



$99,606,293 annually to put out strictly fire engines mean

You've seen it done—throwing a lighted match on a roof. That costs us for fires every year $7,355,037

You would think that everyone knows that molten metal can burn. Yet, the metal ladle burns up every year $155,183

The old familiar story of the cigar on the table. Even sensible business men do it. Annual fire bill: $8,588,375

Patriotism is expensive when it's careless. Fireworks mean $375,409 a year in needless fires

Fires are started by stoves, furnaces, boilers and their pipes through sheer carelessness in most cases. Annual fire bill: $11,204,875

Steampipes: $413,176 a year in fires. Proper inspection and insulation would save this money

Don't read the meter by candle light. Gas starts fires that cost on an average $1,815,597 a year

Grease: $552,130 a year. Too much

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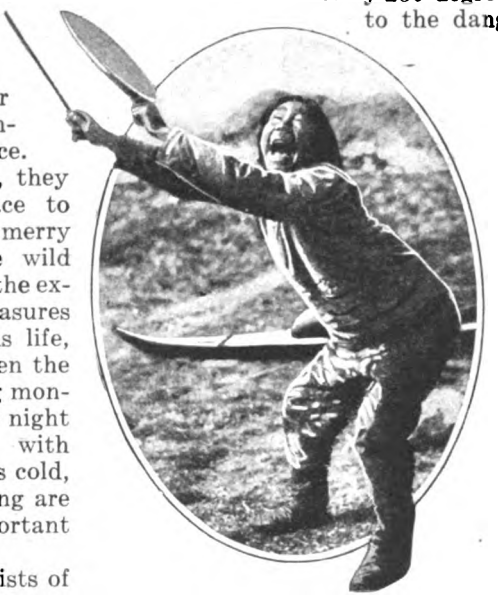
Primitive Peoples Must Have Music and Dancing

TO the Eskimos, as well as to other primitive peoples, music and dancing are important mediums for the expression of their feelings, and much needed outlets for their excessive energy and vital force.

In the summer, they ramble from place to place, engaged in a merry struggle with the wild beasts, and enjoy the excitements and pleasures of an adventurous life, but in winter, when the long and appalling monotony of the polar night overpowers them with its stillness and its cold, singing and dancing are their most important safety-valves.



In spite of his apparently woful expression, this Eskimo is indulging in a joyous dance to his own music

The music consists of singing in unison, accompanied by rhythmic tapping on a primitive drum. Dancing almost always is accompanied by the same chorus.

The illustration shows an Eskimo from West Greenland, singing, dancing and beating his drum.

The drum consists of a frame made of whalebone covered only on one side with a piece of gutskin. The drumstick is made of driftwood. It is beaten on the frame, not on the drumskin.

The Eskimo dance is a series of somewhat primitive movements, but it is very expressive of joyous emotions and excess of energy.—CHRISTIAN LEDEN.

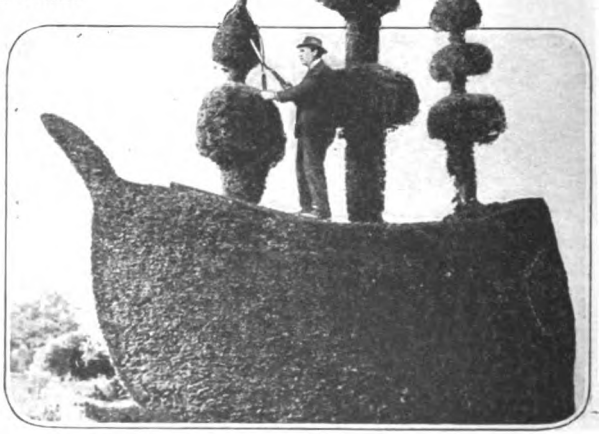
A Few Facts About Picric Acid, Base of Explosives

COAL-TAR, among many other things, contains phenol, and when phenol is nitrated picric acid is produced. This acid is a powerful explosive, but it has the objectionable quality of forming highly sensitive explosive compounds with the metals it touches, so that when used as a charge for shells it has to be coated with some non-metallic paint in order to prevent premature explosions.

The melting-point of picric acid is nearly 250 degrees Fahrenheit. This adds to the danger of its use, since it is desirable to melt it in order to pour a concentrated charge into the shell to increase the explosive force. For this reason, picric acid is usually combined with various substances to lower its melting-point. Lyddite and melinite are two of the compounds.

They Trim This Ship's Sails with the Shears

THIS is not the captain of the *Pinafore*, but an ingenious old gardener who has trained a yew tree on an estate near Cadnam, England, into the semblance of a ship. The gardener may be observed just abaft the foremast engaged in trimming something that may be a sail with a pair of hedge shears. It took fourteen years to make the yew tree shipshape, but anyway, it is safe from submarines.



Its hull is a yew tree's branches; its captain and trainer an English gardener

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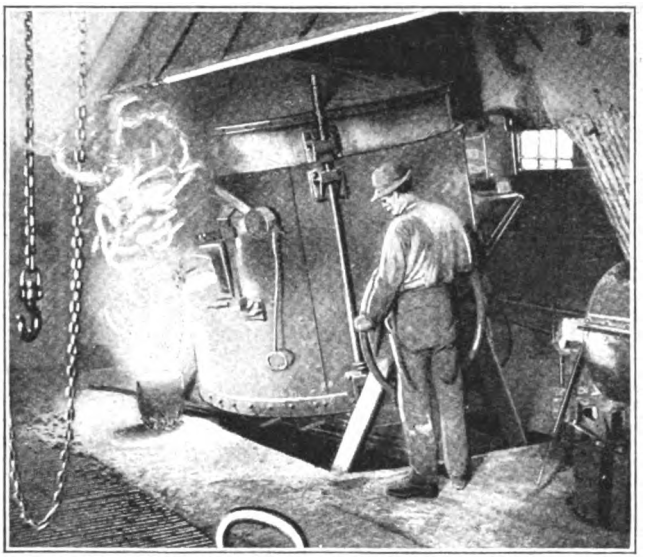
The Crucible Gives Way to Electric Furnace in the Brass Foundry

FOR many years brass, copper, or similar metals for pouring into castings or ingots have been melted only in crucibles. This is still the practice in many plants and foundries in this country. Until recently no other method would serve because of losses due to too high a temperature or to some other cause.



Brass and copper used to be melted only in crucibles; now an electric furnace has been developed, which does much better

But now an excellent and superior electric furnace has been perfected which is successfully melting and pouring brass, and which bids fair to make rapid progress in displacing the crucible.

Electric furnaces have generally developed such a high temperature that much of the metal was lost by volatilization, or spoiled, but this one overcomes all such difficulties.

In such a furnace several thousand pounds can be melted at once, whereas in the crucible no more than one hundred pounds can be so treated at once. The new process, which is the invention of an American, is more efficient, economical and much cleaner than the old. Its merits are such as to be sure of finding recognition from up-to-date foundrymen.

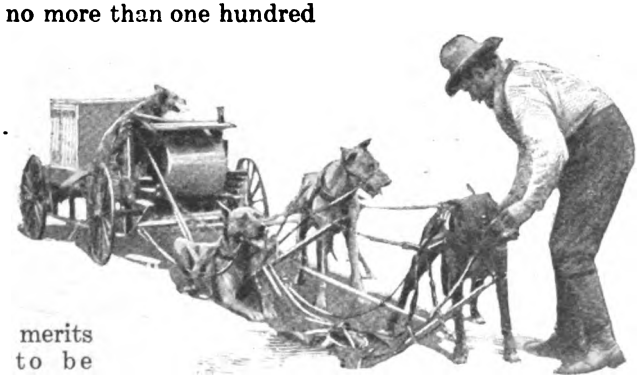
Draft Animals in the War. Five Millions on West Front

THE British have two million horses engaged in this war, according to Premier Lloyd George in a recent statement. It is estimated that the number of horses and mules in service on the whole western front is close upon five millions. A great many horses have been shipped to Europe from America—just how many it is hard to say, and doubtless many were drowned.

A Six-Dog-Power Sledge-Wagon For Overseas Service

READY for Flanders mud or Alpine snow, this dog-drawn ambulance has been given to the American Red Cross for foreign service. It was built by Allen M'Mullen, a trapper, who had handled dog trains in the far North and who took a special delight in training the six great Danes, all blue ribbon winners, that furnish the motive power.

To prove the value of his gift, he drove his dogs from Albany to New York before he turned the outfit over to the Red Cross together with a sum of money that he had collected during the trip.



© Int. Film Serv.

Remove the wheels and this dog-drawn vehicle is all ready for a snow storm or a mud swamp

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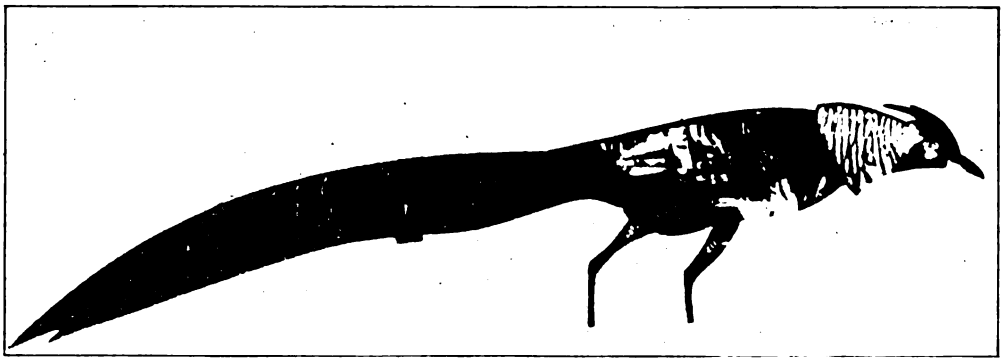
Dame Nature—Instructor in Camouflage

She knew all about the art and her children practised it long before man gave it a name

By A. M. Jungmann



The pheasant is conspicuous enough, isn't he, now that you have him away from his natural background? Now look for him in the picture below and see if you can find him

WHY does the savage paint himself in gaudy colors when he goes on the war-path? Why is the leopard spotted and the zebra striped? Why is the wild duck a mottled dark color on top and light beneath? For the same reason that our "tanks" and ambulances are being painted with stripes and splotches of vivid colors—to make them invisible to their enemies.

Before the war created the French word camouflage, naturalists spoke of "concealing coloration" and "mimicry." In the piping days of peace an American artist, Abbott H. Thayer, devoted a great deal of time to the study of concealing coloration. An essay published by Mr. Thayer in 1896, "The Law Which Underlies Protective Coloration," entitles him to the distinction of being the father of camouflage. Moreover, in 1909, Mr. Thayer's son, Gerald H. Thayer, published a book on his father's researches, "Concealing-Coloration in the Animal Kingdom," which is profusely illustrated by both Abbott H. and Gerald H. Thayer. In America this book called forth a storm of protest. European scientists were more impressed by the points Mr. Thayer brought out. Professor J. Graham Kerr of Cambridge and the University of Glasgow, seeing the military value of Thayer's law, tried to persuade the British Government to create a special bureau to develop war camouflage on the principles laid down by the Thayers.

This is not just a painting of a wood scene. It's a portrait of a pheasant at home—the pheasant in the picture at the top of this page. The colors blend perfectly with the scenery

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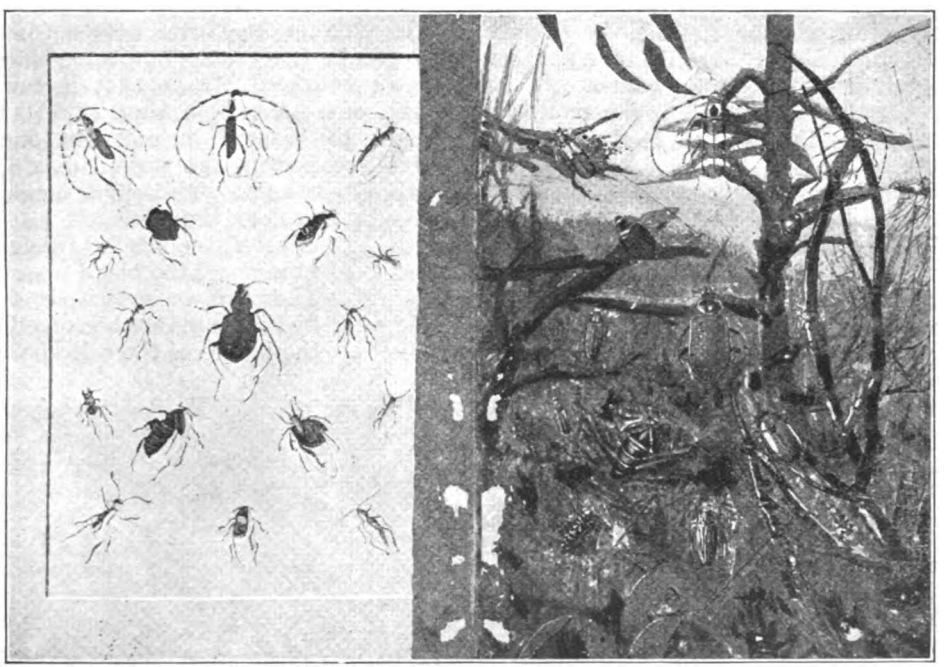
This book is also known to have played a leading part in the development of camouflage in Germany! There are signs that the Germans have mastered the significant *laws of disguise* which this book discloses, more thoroughly and more effectively than any of the other warring countries.

In this country Mr. Abbott Thayer has been actively engaged in working out problems of military camouflage and many of his designs are now in use by both the French and the British forces at the front. He points out that the reason the rabbit at rest on brown turf, the copperhead snake among dead leaves in the forest, and the birds in their native haunts are so inconspicuous that unless they move it is very easy to overlook them, is because these animals wear a picture of their background. His remarkable nature paintings, some of which are reproduced here, prove his point conclusively. To quote Mr. Thayer: "The study of protective coloration is in fact the study of nature's scene-painting on the coats of animals."

It is easier to conceal a flat object than it is to conceal a round, solid form. And here comes in the principle, discovered by Mr. Abbott Thayer, called *counter-shading*. As Mr. Thayer says: "The roundness and solidity are plainly shown by lights and shadows. Tinker as we will in the attempt to cover the object with a picture of its background, it still insists on standing out in its own proper place as a solid thing, with the lighted upper surface facing towards the sky, fading down into darker and darker shadows on its under side. . . . On whatever portions of the object are most brightly lighted, there we put the darkest paint, and on whatever portions are most darkly shadowed there we put the lightest. *Pure white* pigment is as a rule required to lighten-up the extremes of shadow. Thus we *paint the shadows out of sight*, and the high-lighted areas likewise, with intermediate shades for intermediate portions; and the result is a rounded object that *looks* exactly like a *flat* one. It can then be "obliterated" by a background-picture just as the flat one was, the picture, however, having to be made consistent with the countering of lights and shadows on the rotund surface."

Our Army recognizes camouflage as an important branch of military science.



There are seventeen bugs in the picture on the right. The picture on the left will help you to find them. The positions of the bugs are the same in both pictures

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These girl finger-print experts of the Navy make a business of holding sailors' hands against the ink

If You're in the Navy These Girls Have Your Finger-Prints

TO the four girls in this picture belongs the Navy record for holding hands. It is sense not sentiment that moves them, since they are the finger-print experts of the service and have recorded, classified and filed an impression of the digits of every bluejacket from the admiral down to the latest recruit. The entirely painless operation that the young man is undergoing will be finished in exactly five minutes after it began, and in another five minutes the young women will be able to tell whether the young man is a repeater, for their system is one of ready reference.

The finger-print experts are Miss Blanche Donohue and Miss Marie Dahm, of New York, and Miss Blanche Stansbury and Miss Julia G. Boswell, of Alexandria, Virginia.

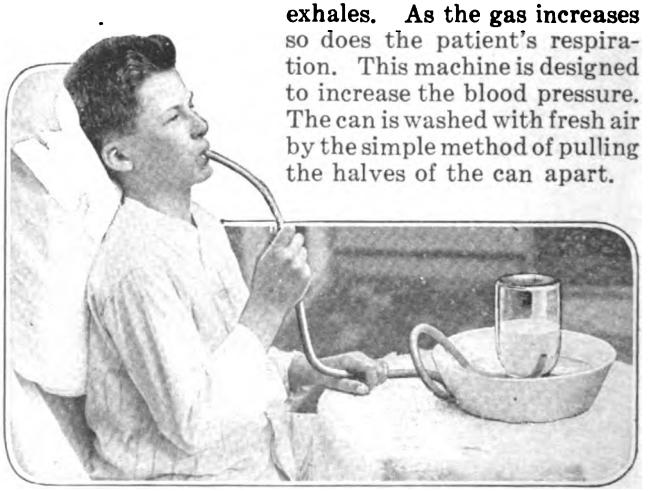
Blow Bubbles and Heal Your Wounded Lungs

SIMPLE methods have been devised for treating wounded soldiers at the front. Those suffering from wounds in the throat and chest can improve their condition by blowing bubbles in a bottle of water, according to Dr. Pescher, a French surgeon.

The bubble-blowing device is simply a long rubber tube attached to a bottle that rests in a basin. In order that the patient may receive the full benefit of the treatment his body should be erect and his chest thrown out so that the lungs may be well expanded. The best effects are obtained by inhaling through the nose, slowly and regularly, and blowing through the tube, compelling all the water in the bottle to run off into the basin below. This exercise should be practiced thirty times during each treatment. When the lungs improve, a larger bottle is used.

In making this apparatus ready for use it is necessary to pour a small quantity of water into the basin, and then place the water-filled bottle, mouth down, in the bottom of the receptacle, taking care that the water does not run from the bottle. One end of the tube is placed in the neck of the bottle and the other in the mouth of the patient. Treatment given in this manner will aid the patient to regain his breathing facilities.

Dr. William T. Porter uses a tomato can cut in two, each half being shoved over a collar of tin so that it can be drawn out. A rubber tube enables the patient to breathe in and out of the can, filling it with the carbon dioxid he exhales. As the gas increases so does the patient's respiration. This machine is designed to increase the blood pressure. The can is washed with fresh air by the simple method of pulling the halves of the can apart.



To strengthen his lungs the wounded soldier blows the water out of the bottle 30 times in one sitting

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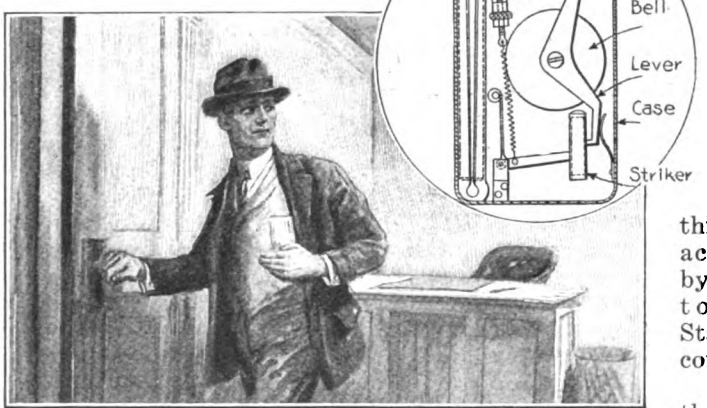
The Bell Rings When You Forget Your Fountain Pen

HAVE you the habit of walking away and leaving your fountain pen on a strange desk? If so, you will be interested in the device which Dermot Donelan of London has invented.

You must, of course, use a special kind of fountain pen—one which has a case with spring holders having one side free to move by means of their own elasticity. Chains attached to these holders are fastened to a lever which, by means of a spring, holds in place a flexible striker for a bell. When the pen is in the case and the plug for the cover has been put on, the holders are forced away from the sides and the chains are slackened. However, when the pen or the plug are removed the holders contract and tighten the chains. Then the lever is drawn away from the striker and the latter is free to come in contact with the bell. It does not sound, however, as long as the person carrying the case is still. But when he moves, the striker sets up a pendulum-like motion and the ringing of the bell follows, calling attention to the fact that the pen is not in the case.



When the fountain-pen owner rises to go a bell in his pocket reminds him that he has forgotten his pen

It seems to us that this device is more ingenious than useful. Why not an umbrella that cries when it is left behind? It would be moreserviceable than the fountain pen bell that rings.

Relieving the Hand That Rocks the Cradle

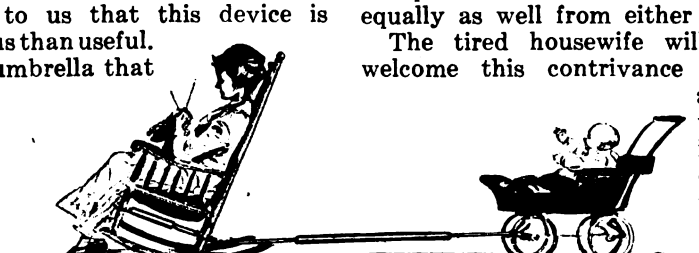
WONDERFUL as this age of invention is, no one dreamed that some day the wealth of energy wasted by the swinging of a rocking-chair would be intrepidly harnessed, subdued, and regulated to do the work of mankind. But, nevertheless, this very thing has been accomplished by an inventor in the State of Wisconsin.

Briefly told, the invention consists of a telescoping rod hinged at one end and clamped to the rungs of a rocking-chair. The other end is fastened to the front axle of the baby-carriage.

It is clear that a movement of the rocking-chair will impart a backward and forward movement to the baby-carriage. The plan is an excellent one, since from your seat in the rocker you are not obliged to watch the contortions of the baby's face while it is crying itself to sleep.

By grasping the handle of the baby-carriage it is possible to put the baby and grandma to sleep with a single sweep so to speak. The contrivance will work equally as well from either end.

The tired housewife will no doubt welcome this contrivance with open arms. What will these inventors do next to make baby-minding a pleasure instead of a drudgery?



The war bride knits socks for hubby at the front and puts baby to sleep at the same time as she rocks

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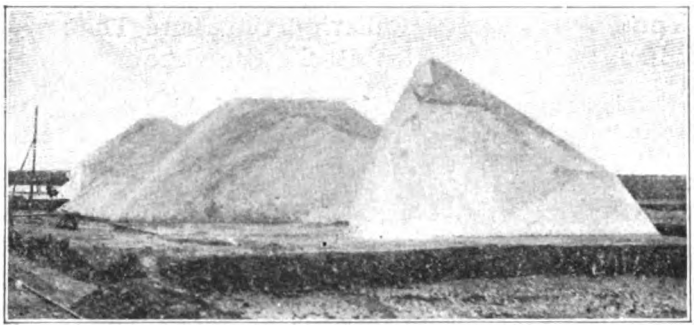


© Brown and Dawson

The big whitish heaps are salt which has been obtained from sea water by evaporation and is ready to be shipped inland

Drying Sea Water to Get Salt—the Spanish Way

THE use of salt for seasoning and preserving foods is so ancient that the earliest written records refer to it. For many centuries practically all the salt used by the human race was procured by the evaporation of sea water. This method of obtaining salt is still employed in many localities where the conditions are favorable. A flat stretch of sea coast and a hot and dry climate are necessary if salt is to be gotten from sea water. An ideal locality for this industry is the coast on the Bay of Cadiz, Spain, where the picture of the salt hills was taken.

The sea water is allowed to collect in shallow basins, barely above high water mark. As the water evaporates, the various salts contained in the sea water crystallize out and form a crust, which is removed and shoveled in small heaps. There the salts undergo the first stage of purification. The edible salt is drained from the other salts which constitute the greater part of the impurities. The edible salt crystallizes out first, while the other salts retain the water and form a concentrated brine which is allowed to run into ditches dug for that purpose.

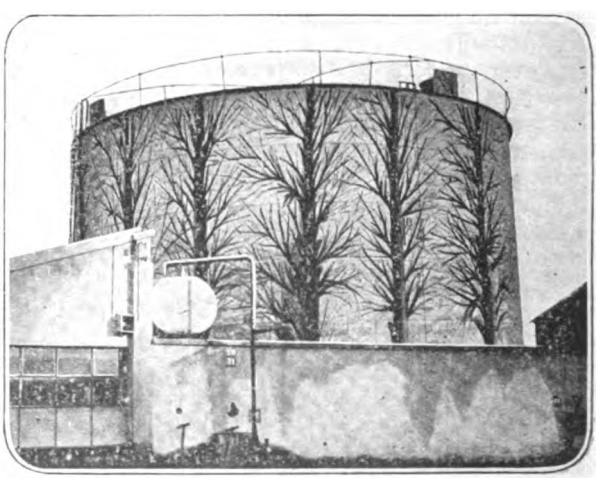
The partly purified salt is then gathered into large heaps, several of which are shown in the picture. Occasional rains wash out the more easily soluble impurities, and the hot sun dries the salt on the surface of the pile. Although it still contains about fifteen per cent. of impurities it is shipped in large quantities without further refining.

A considerable part of the crude salt is used locally for curing and pickling. The refining of the salt for table use is left to the numerous small local refineries scattered throughout the country.

A Roumanian Oil Tank That Was Camouflaged Into a Grove

THE art of camouflage has been practised in this war by all belligerents more or less skilfully, and particularly on the West front it reached its highest development. But even in the Balkan countries the value of camouflage was recognized and the accompanying picture shows that the Roumanians were not unskilful in disguising important buildings and other structures—oil tanks, for instance. The little grove painted on the sides of the tank is perhaps a trifle stiff, but at a distance it may, indeed, mislead the enemy bent upon destruction.

Camouflage of this kind may afford fairly good protection against an enemy on nearly the same level, but scarcely against an aviator or observer in a balloon.



© Underwood and Underwood

At a distance this oddly decorated oil tank may look enough like a grove to deceive the enemy

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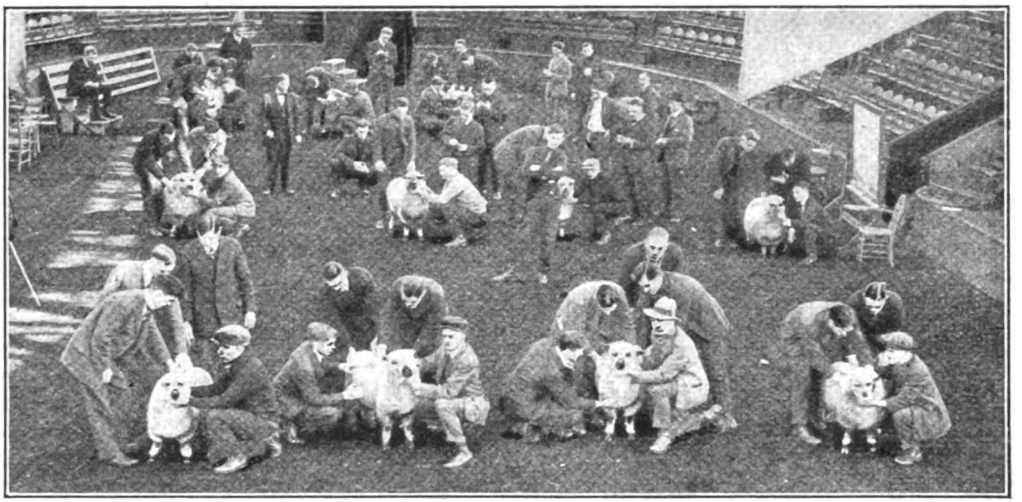


Students at Purdue University judging sheep in the Judging Competition, which is held at the close of the Winter course in Animal Husbandry

Learning How to Judge Sheep in a University

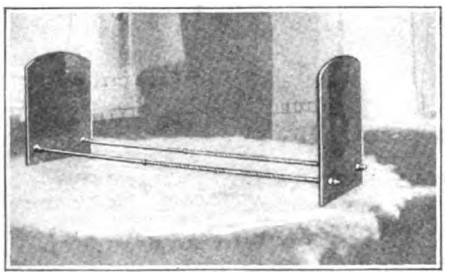
NOW, as never before, the country needs both wool and mutton. Our soldiers require wool for uniforms and blankets, and both the men in the service and the noncombatants must have meat. Therefore, the raising and breeding of sheep has become a very important and profitable branch of farming. The United States Department of Agriculture is now actively engaged in educating farmers and particularly farmers' sons, in the care and selection of sheep. Sheep-judging has been made a part of the regular secondary, or high school work in the sheep-raising districts. The students are taught the proper way to judge the merits and demerits of any given breed of sheep, from the point of view of the wool production and for butchering. By means of charts and diagrams they are first taught the names of the different parts of the carcass.

In the judging of wool sheep care is taken to instruct the students in the different kinds of wool and their characteristics, as well as the breeds of sheep that are most desirable as wool producers.

A Book-Rack Which Adjusts Itself Automatically

TABLE book-racks are always a convenience, and can be made very attractive and ornamental too. With the ordinary rack, however, the removal of two or three books causes general disorder, for all the rest fall over and make the appearance anything but prepossessing. Here is a rack that precludes all that by adjusting itself to the number of books that it contains.

It is made with the usual wood or metal ends, which are connected by two telescoping brass tubes. Inside the tubes are coil springs which are fastened to the end-boards, and which tend to draw them together. The spring is not so strong that it interferes with the removal of the books, but there is sufficient tension to cause the ends to rest snugly against the end books, and close up as the books are removed from the rack. The ends can be covered inside with felt to prevent the possibility of scratching the book covers.



Coiled springs inside the brass tubing hold the book ends firmly against the books

When not in use this adjustable rack takes up less space than the ordinary rack and costs less for transportation.

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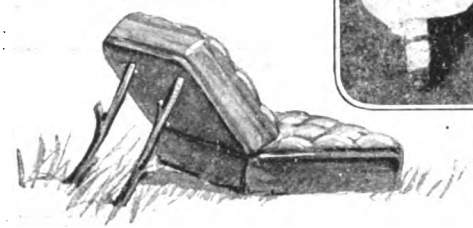
Every Auto Has a Picnic Seat All Its Own

MUCH of the comfort in life comes of making good use of the things we have. Mrs. William J. Chievitz, of Cleveland, Ohio, proved that when she found that the seat cushions of her automobile and two sticks made the most restful of outdoor couches. No need, if you follow her plan, to take along even a folding camp chair when you motor off for an afternoon in the woods or at the seashore since the cushions are always with you, and it must be a desert place indeed that won't provide the two sticks necessary to prop up the back of the improvised divan.

This most comfortable outdoor seat is made of two automobile cushions



Pick your sticks right and you can adjust the back to your own idea of luxury

A comfortable seat is very desirable on a picnic. A good plan is to prepare two stout sticks of a proper length which can be carried in your automobile for this very purpose. The length can be determined by removing the seats, adjusting the cushions at the proper angle, and cutting the sticks to fit.

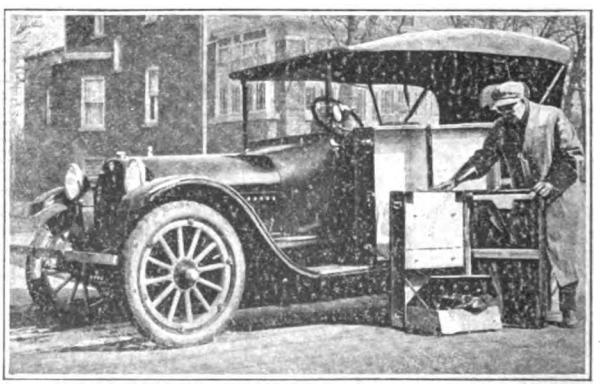
Automatic Telephone System Invented by Undertaker

INVENTORS who have new ideas which are foreign to their vocations or lines of business may derive encouragement from the fact that the inventor of the first practical system of automatic telephony was Almon B. Strowger, of Kansas City, who took out a patent in 1889. The inventor of the Strowger system was an undertaker who was in no way connected with electrical engineering or with any telephone enterprise.

Carry a Wardrobe on Your Car's Running-Board

TOURISTS traveling long distances in their automobile do not mind wearing old and even shabby clothes while they are riding. But, when they stop at some fashionable hotel or at the elegant summer home of their friends, they want to appear at their best. How to carry finery along on a long trip and how to keep it unwrinkled and free from dust and moisture has always been a vexing problem.

A dust-proof wardrobe trunk recently invented offers a welcome solution of this problem. It consists of an inner case, the real trunk, which fits closely into a substantial outer case, which is fastened by bolts to the running-board of the automobile. One-half of the trunk is divided into drawers and compartments for hats, shoes, veils and lingerie. The other half has hangers to hold men's or women's garments so that they will not become wrinkled. The inner container has handles and can be taken out and carried to the owner's room, while the outer case remains in position on the car. While traveling the trunk is covered with a dust- and water-proof covering as an additional protection for the contents from the ravages of the elements.



For travel-comfort and respectable appearance carry a wardrobe trunk on the car's running-board

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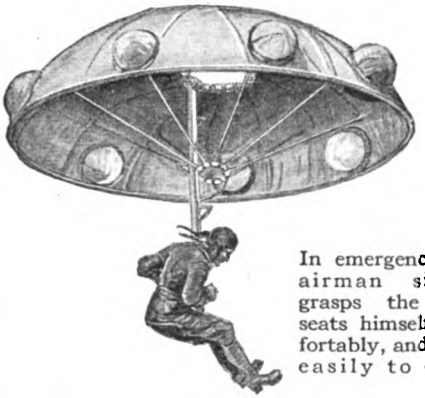
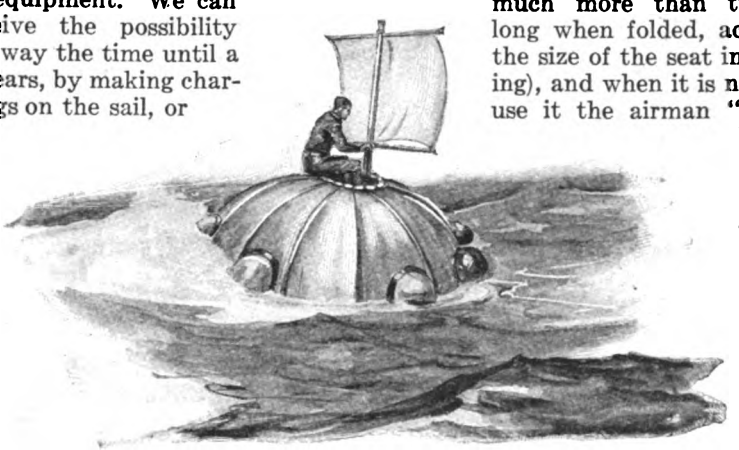
The Parachute de Luxe

This safety contrivance has almost all the conveniences of an up-to-date hotel



In emergency, the airman simply grasps the pole, seats himself comfortably, and drops easily to earth

WHY don't our War Department officials wake up? We present here for their serious consideration a recently invented parachute which provides all the conveniences of a hotel. It's a joy to trust one's life to that parachute, after a balloon has been shot to pieces or an airplane has become unmanageable. You have comfortable seating accommodation, facilities for swimming and bathing, a sail for yachting, and gymnastic equipment. We can even conceive the possibility of whiling away the time until a rescuer appears, by making charcoal drawings on the sail, or comfortably taking a sunbath on the exterior, or playing solitaire with the waterproof cards, the inventor having thoughtfully provided everything, including steps for the mast on the bear-pole principle, and access to the roof.



Alighting on the water after a perilous descent he hoists the sail and heads for home in a spanking breeze

Broadly considered, the parachute is a gigantic umbrella of fabric, properly stayed and arranged to open like a regular parachute. It has a hollow stem within which is a collapsible mast, carrying a sail that can be hoisted to different heights for navigating or signaling. The "handle" of the umbrella is a nice, comfortable tie-up seat, for the user's convenience. As the inventor innocently remarks, "he may rest with his body partly submerged if desired," thus, you will note, providing facilities for water sports. Around the edge of the umbrella top are a number of rubber fabric air receptacles, each of which has a funnel-shaped aperture on the lower edge, with a clap-valve in the neck, so that they will inflate with the rush through the air and will buoy up the apparatus if it should strike the water. Why does the water thoughtfully refrain from entering the clap-valve too? The inventor is silent on that point.

The machine is to be carried "in any convenient manner upon an aircraft," (there being much spare room on an airplane, and this apparatus could not be much more than twelve feet long when folded, according to the size of the seat in the drawing), and when it is necessary to use it the airman "grasps the lower part of the pole and adjusts himself on the seat." This, of course, is quite a simple operation; one merely has to emerge from the wreckage, grasp the pole, and jump out.

Having lightly floated down like a particle of thistledown, and alighted gracefully like a tired bird, the rest is simple, if he is on the ground; but if he is on the water, then the comforts of the parachute discover themselves. The aviator, feeling like a giant after his exhilarating flight and cold plunge, climbs up the pole and makes himself at home.

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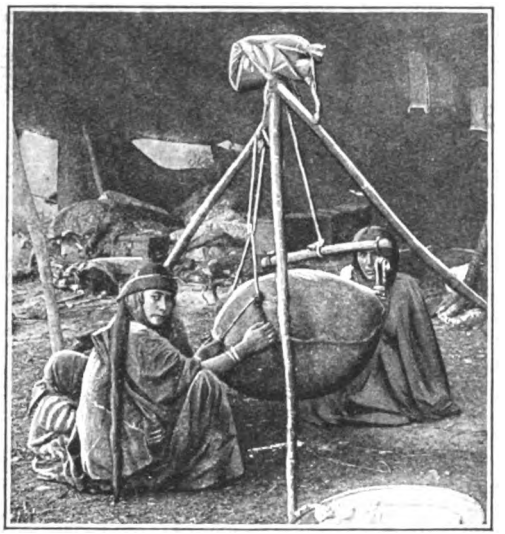

It takes a long time to make butter with this churn, but time is the one thing the women of Mt. Sinai have in abundance

Milk and Churn Are Both Supplied by the Goat

ABOUT seventy miles northwest of Mount Sinai—where, as you remember, Moses received the Commandments—is a butter factory, the machinery of which has not been improved since his day. It consists of a bag of goat skin suspended from a tripod of poles. The Bedouin women partly fill the bag with goat's milk and then have plenty of time to discuss the neighbors as they patiently rock the bag until the butter is separated from the whey.

Weld the Liberty Bell So It Can Speak for Victory

IT has been suggested that the Liberty Bell be welded with an oxyacetylene welding torch and rung when the Germans are beaten and the war is ended. Welding restores the tone of a bell completely, making it as melodious as when new. Welding should be done on the inside of the bell. There will be nothing to show it was ever cracked.

Making the Dirt Fly in Korea on the Tug-of-War Principle

WHEN they have an important excavating job on hand in Korea, the contractor doesn't have to wear out brain matter worrying over machinery to do the work. All he needs is a broad shovel with two holes through the blade, two stout ropes roved through the holes and plenty of man power to pull. That's the way the foundation work for the new post-office building in a suburb of Seoul, the capital of Korea, was started, and a glance at the picture will show you that the very best sort of training for a Korean contractor would be to serve as captain of a tug-o'-war team.

Since this is the first shovelful perhaps they are putting frills on the work, but twelve men to one medium sized shovel does seem a waste of power. Readers fond of statistics may figure out for themselves how long it would have taken to dig the Panama Canal with this kind of power: then they can calculate what we owe the man who set steam to work. Fortunately, labor is cheap in Korea and time not much of an object. At that they will probably finish the job while New York is still digging out its new subway.

Twelve men to one shovel! How long would it have taken to dig the Panama Canal on that principle?

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The Horse of Joy—A New Outlet for Animal Spirits at Coney Island

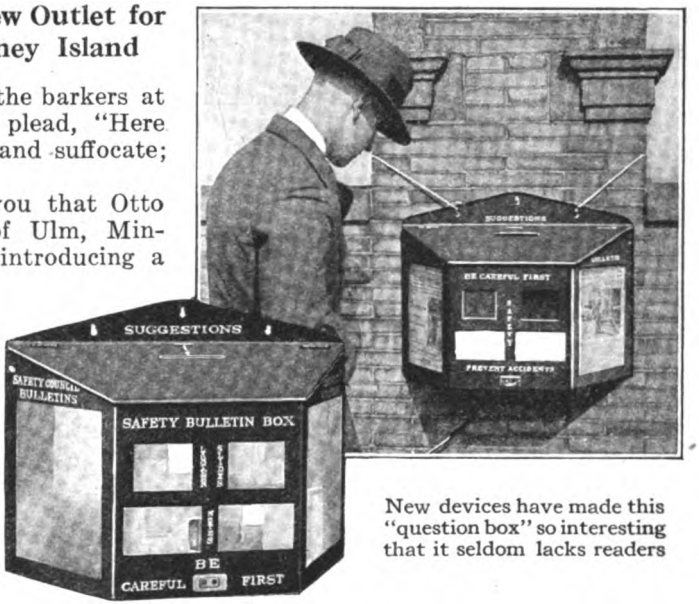
EXPRESS no surprise if the barkers at the amusement resorts plead, "Here you are, boys, lift a ton and suffocate; it's barrels of fun."

It will simply assure you that Otto Fritsche, a jovial citizen of Ulm, Minnesota, has succeeded in introducing a device which is intended to give you another outlet for your pent-up but exuberant spirits.

The amusement device consists of an apparatus made to look like a horse, the body of which is to be constructed of double walled aluminum. The horse of joy is provided with a door through which the merrymaker enters, his legs protruding from below the body. On the interior will be found a pair of shoulder straps, which will take the load off his head. A small gasoline motor drives the "horse" forward, and as it does the seeker of the blue-bird takes the necessary steps to maintain equilibrium. A periscope is provided which extends from the interior of the frolicsome equine out over its head.

Otto has ingeniously arranged to have the exhaust pipe of the gasoline engine run along the upper wall and out of the horse's ears. Doubtless, Otto wants the horse to appear very realistic and high spirited through its ears.

Aside from the fact that the contraption is supported in the rear by a pair of large wheels, that the front is supported by a human being, that a periscope protrudes from the head, and that exhaust gases puff from its ears, Otto believes it will be mistaken for a real animal. It might be on a dark night.



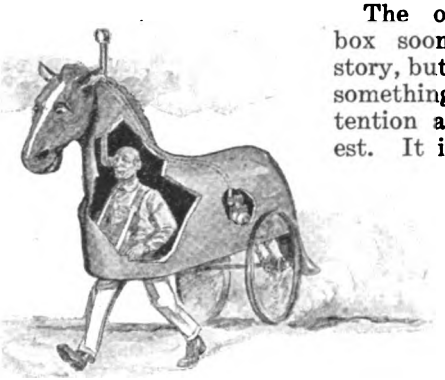
New devices have made this "question box" so interesting that it seldom lacks readers

Making Them Stop, Look, Heed, and Help

A SILENT but most efficient worker in the "safety first" campaign of the United Gas Improvement Company, of Philadelphia, is a box provided with a flashing light which throws into bold relief lantern slides that teach lessons of carefulness or display "horrible examples." The box is an adaptation of the ordinary suggestion box adopted by many large employers. It has spaces on the side for the display of letter-size bulletins as well as the lantern slides, and a slot in the top through which bright ideas may be dropped in written form.

The ordinary suggestion box soon becomes an old story, but this one always has something new to attract attention and stimulate interest. It is strongly made of light sheet metal and contains a flash lamp, double-glass slides, and a short section of insulated cable.

The box installed by this company more than paid for itself in a short time.



We would like to interview any man who has tried this form of amusement and has survived

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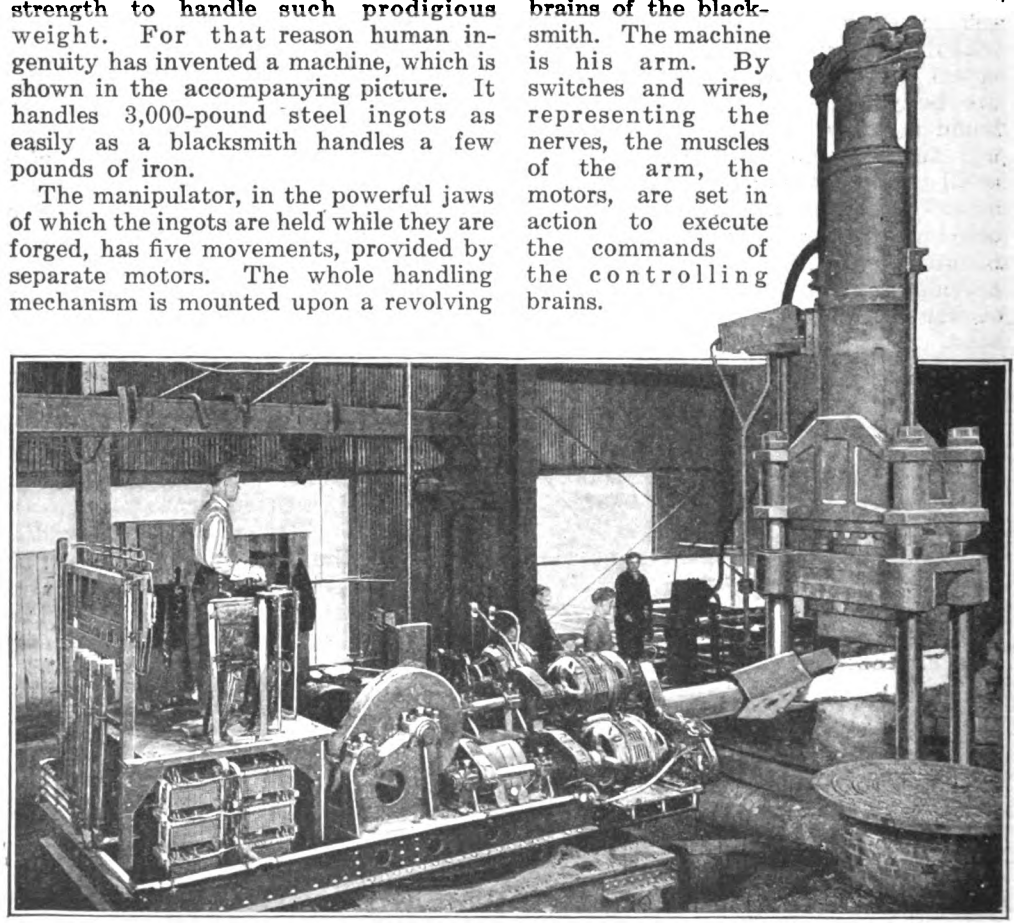
Handling Tons of Metal Like a Toy

A giant blacksmith of steel and iron with a human brain in full control

DID you ever watch a blacksmith at work, forging a horseshoe or some other object of wrought iron or steel? With his tongs he draws the glowing metal from its bed of fire in the forge, and resting it upon the anvil he begins to hammer it into shape. His powerful arm turns, bends and twists to bring the hot metal in just the right position on the anvil.

In big steel works steel ingots weighing 2,000 or 3,000 pounds are forged under a gigantic drop hammer or in a hydraulic press. A blacksmith's arm has not the strength to handle such prodigious weight. For that reason human ingenuity has invented a machine, which is shown in the accompanying picture. It handles 3,000-pound steel ingots as easily as a blacksmith handles a few pounds of iron.

The manipulator, in the powerful jaws of which the ingots are held while they are forged, has five movements, provided by separate motors. The whole handling mechanism is mounted upon a revolving table or platform resting upon a truck. The truck runs on a six-foot gage track and has a forward and backward movement of eighteen feet. The jaw-operating arm has a diameter of about twelve inches and ends in jaws three feet long. The arm revolves and also has an up-and-down motion, like an elbow joint. The manipulator has two eleven-horse-power and three fifteen-horse-power motors for driving the operating mechanism. The man on the little platform, with his hand on the lever, controls every motion of the huge mechanism. He represents the brains of the blacksmith. The machine is his arm. By switches and wires, representing the nerves, the muscles of the arm, the motors, are set in action to execute the commands of the controlling brains.



The man on the platform is the brain of the blacksmith, the machine is his arm. With it he does the work which formerly required seven men

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Tale of a Tub, for Which Supply Your Own Moral

THE man who put the bathtub where it appears in the picture is not a crank on open-air bathing. In fact, we hasten to appease Mrs. Grundy by announcing that the tub has been turned from its original purpose and made into a very efficient trough for horses.

But it wasn't thrift that put the bathtub on this job under the pump; quite the contrary. The man on whose place it stands has a fine artesian well, and he installed a force pump, intending to put water into his house. Anticipating this improvement, he bought a bathtub. Then he procrastinated and finally put the tub under the pump instead of in the bathroom, which is still without water, although several years have passed since the tub took temporary employment as a watering trough.

Not a country substitute for a bathing beach, but only a bathtub put to unusual uses

The Physical Sciences and the World War

ACCORDING to Dr. G. W. Crile, writing in the Pennsylvania Medical Journal, "The present war is a contest of ideas rather than of men. In its broad sense it is the practical application of physics, chemistry and biology in a mass struggle for the existence of nations."

Automobiles in the Philippines

IN the Philippines civilization is progressing slowly outside of Manila and some other centers of population. The accompanying picture shows one of the primitive ferries which cross the Sumag River. It is merely a big bamboo raft, unpretentious and crude, but it is evidently strong enough to ferry an automobile across the picturesque river. A rope is used to pull the raft from one side of the river to the other.

© Brown and Dawson

We wonder what they charge on the Sumag River in the Philippines to ferry you across on a bamboo raft. We should not mind paying anything if they would guarantee a safe landing

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When the old barber's apron goes, you will be imprisoned in a kind of lampshade from which your curly locks protrude. The hair falls into a gutter

Hair-Cut? Yes? — Then Poke Your Head Through This Lampshade!

SCORES of inventions have been made and generally introduced by which the various beautifying operations usually performed in barber shops were made more satisfactory and less painful. But the bib or apron, that traditional concomitant of hair-cuts, has endured through centuries, in spite of its disgusting and unsanitary features. Now, at last, an Australian, Donald McLeod, of Lang Lang, Victoria, has made an invention which, if generally adopted, would do away with the ancient apron.

McLeod offers as a modern substitute for the apron a device shaped like a lampshade. It is made either of metallic segments or of one continuous piece of flexible material in the form of a truncated cone. The narrow part of the cone is fastened around the neck. The cone, resting on the shoulders, covers and protects the body from the falling hair. A gutter at the lower edge of the cone prevents the cuttings from sliding down the smooth surface of the cone, and falling upon the ground. The hair remains in the gutter and can be swept to a chute provided for the purpose and dropped into a receptacle. The inventor has provided several methods for fastening the cone, and as an additional sanitary feature he suggests the use of a fresh collar, attachable to the upper edge of the cone, for every patron.

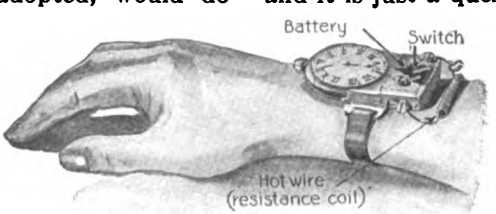
A Silent Alarm Wrist Watch That Burns the Sleeper

A SILENT alarm wrist watch has been designed with the object in view of waking a person without annoying the neighbors. If successfully attained, the object should be much appreciated in the average boarding house and is worthy of commendation. A current-heated wire about the wrist is supposed to scorch the sleeper sufficiently to make him open the switch, and he usually does so without wasting time in dreamland.

The necessary current is supplied by a miniature battery, also worn on the wrist, and a small switch lever is inserted in a space beneath the watch crystal opposite the predetermined hour. When the hour hand has reached the proper point it closes the switch and scorches the victim prone to oversleeping.

The alarm itself is undoubtedly silent, and it is just a question whether the yell emitted by the sleeper annoys the neighbors less than does the ordinary alarm clock.

However this wrist watch will prove invaluable at the battle front which demands heroic remedies for sleepiness.



A hot resistance coil burns into the flesh of your wrist the truth that it is time to get up and go about your duties

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It Takes Fifty Men to Transport an Observation Balloon

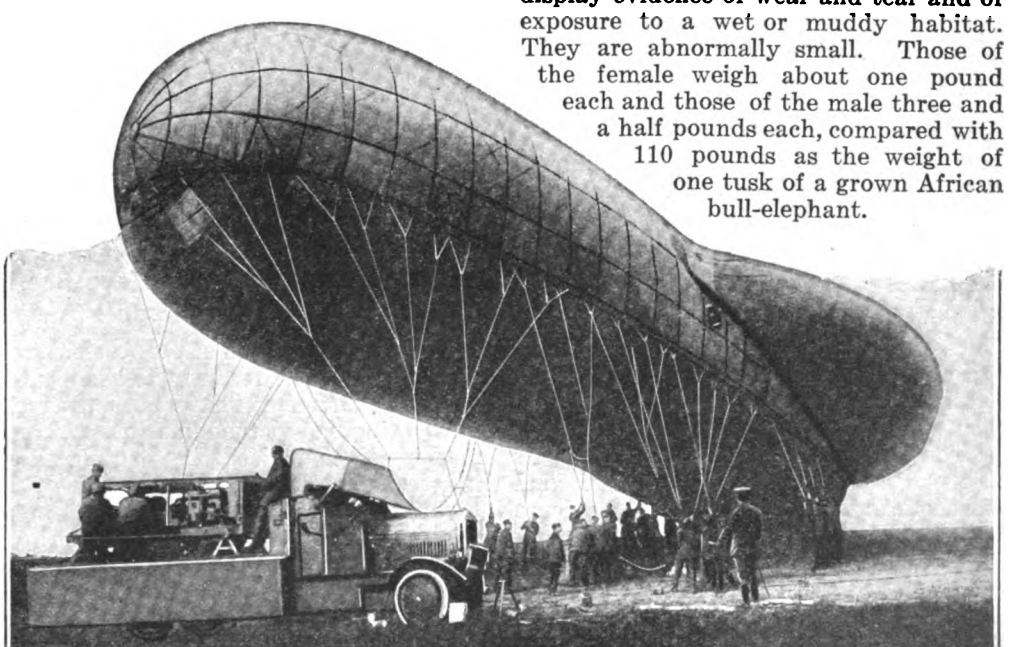
KITE balloons are used extensively in the present war on all fronts. Together with the numerous airplanes employed by both sides, they constitute the most important means for observation and fire control. Observation balloons are particularly useful in trench war, which, as a rule, means practical immobility of the lines for long periods. That does not mean that observation balloons cannot be used to advantage on marches. They can be used and are used even then, but only under the most favorable conditions.

Kite balloons are big and awkward to handle, require a great deal of apparatus with a correspondingly large force of men, and are difficult to transport in an inflated condition. One of the average-size observation balloons used on the West front requires a crew of at least forty-eight men; larger balloons even more. The park of a field balloon company consists of six gas wagons, one balloon wagon, one rope wagon, one requisition wagon, one ladder wagon, and two provision wagons. Formerly the wagons were drawn by horses, but in the present war motor-trucks are used almost exclusively for the heavy work of transporting the gas-making plant, the balloon itself, and the rope or cable drums. Observation balloons are used mainly to watch enemy movements back of the front line trenches; on which account, and to keep out of range of his anti-aircraft guns, they are sent up to high altitudes. There they are exposed to enemy airplane attacks, so that at all times aviators must be ready to fly up for its defence.

Look for the Pigmy Elephant When You Go to the Circus

TWO specimens of a hitherto unknown species of elephant, a real dwarf variety, have been captured in Africa and were recently taken to England. This is considered a most important zoological discovery, comparable with that of the okapi in the Congo forest several years ago. These pigmy elephants grow to be five and a half or six feet high; that is, half the height at the shoulder of an ordinary African elephant.

The tusks of the two dwarf elephants now in England are very dark, and display evidence of wear and tear and of exposure to a wet or muddy habitat. They are abnormally small. Those of the female weigh about one pound each and those of the male three and a half pounds each, compared with 110 pounds as the weight of one tusk of a grown African bull-elephant.



An average captive balloon requires a crew of at least forty-eight men. Six gas wagons, one balloon wagon, one rope wagon, and four supply and tool wagons constitute a balloon park

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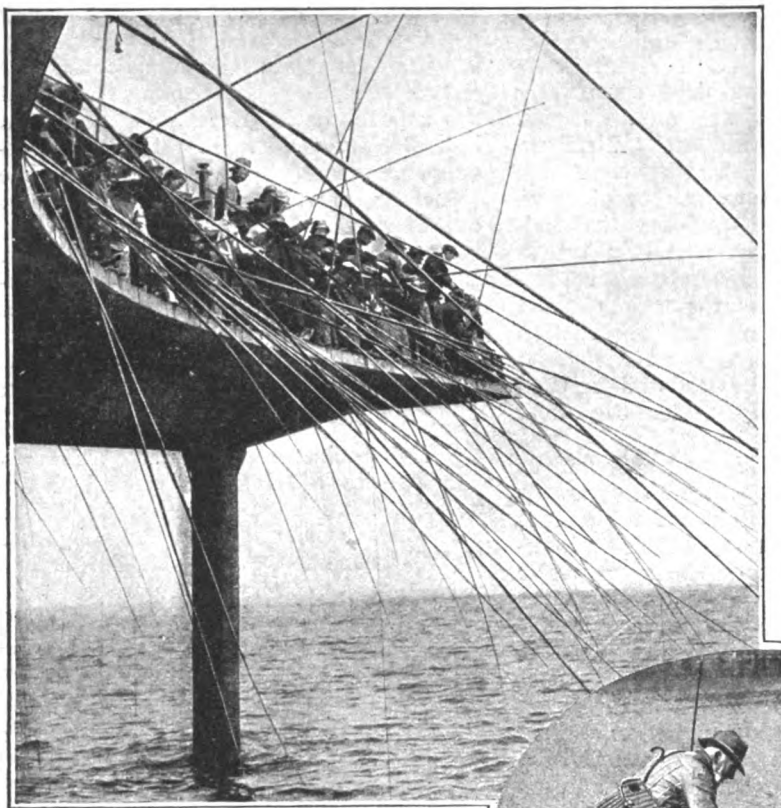

It was Izaak Walton who said sententiously that angling "begat habits of peace and patience in those that professed and practised it." That's true of your lone fisherman, Izaak, like the one pictured below, for instance. But what of the wrangling hundreds on a small city wharf? The crowd in the large picture was photographed while the mackerel were running along the California coast

A Fine Chance for Trouble Here When the Fish Begin to Bite

LOOK at the picture of the ocean pier, crowded to the limit with men and women fishing for mackerel. They may catch fish, perhaps tons of them. Is that sport? Lines become tangled, hooks fasten themselves to hats, clothing and skin of the fishermen, and the scorching sunlight, reflected also by the water, burns and blisters the skin, adding tortures to the discomforts and irritation of the sweltering crowd. Do you think you would enjoy that kind of fishing?

Now look at the other picture! It fairly breathes blissful quietude and peace. A pond or lake, framed by a dense growth of trees, clear water, a convenient pier and the assurance that the water is well stocked with the gamest kind of trout—what else could the lone fisherman wish to complete his contentment and happiness, unless it is to be spared the annoyance of unwelcome intruders?

One-Man Submarines Have Been Found Impracticable

"MANY hundreds of proposals," says a bulletin recently issued by the Navy Department, "have been received, advocating one-man submarines and submarines of small size, to be manufactured in great numbers for the purpose of attacking and destroying the larger type of enemy submarines. This subject has been given exhaustive consideration, and it has been conclusively proved that no small submarine can be provided with the necessary power, speed, equipment, and living quarters for the crew to enable it to operate successfully in the submarine zone."

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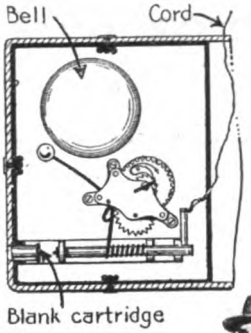
A Shock for the Thief Who Steals This Bag

THE sneak-thief or hold-up man who snatches a bag or suit case equipped with the alarm device recently invented by Alexander Bull is likely to get the shock of his life. It's a simple device, which may be attached to any sort of bag or grip and which consists of a bell and blank cartridge alarm which are actuated by pulling on a string looped around the wrist.

Imagine yourself the owner of Bull's burglar-foiling bag. You dispose within its interior your Liberty Bonds and your last week's pay and snap the lock. A thief attempts to snatch the bag. He pulls it. As he does so, the tightened string releases a trigger inside the bag which fires a blank cartridge. That ought to be enough. But Bull is thorough. He has provided an alarm bell run by clockwork, which is set off at the same time that the cartridge is fired and will ring continuously long enough to make it difficult for the thief to escape with his booty. Oh, yes; but what happens on a lonely street at three a. m.?



You guess correctly. The thief is trying to steal the bag. But it has a string to it

Teaching Waiters to Wait

THE traveling public patronizing the dining cars is fastidious and impatient and the waiters in these cars must be exceptionally efficient to satisfy the patrons. To maintain the highest degree of efficiency of service in their dining cars, one of the large western railroad corporations has established a school which all the waiters in their dining cars are required to attend. A fully equipped standard dining car has been set aside for the purpose. The classes are under the supervision of the old and experienced waiters who teach the raw recruits the art of serving. The accompanying picture shows the dining car school in session.

It seems that waiting is one of the fine arts. One of the large railroad corporations maintains a school in which dining-car waiters are taught how to wait

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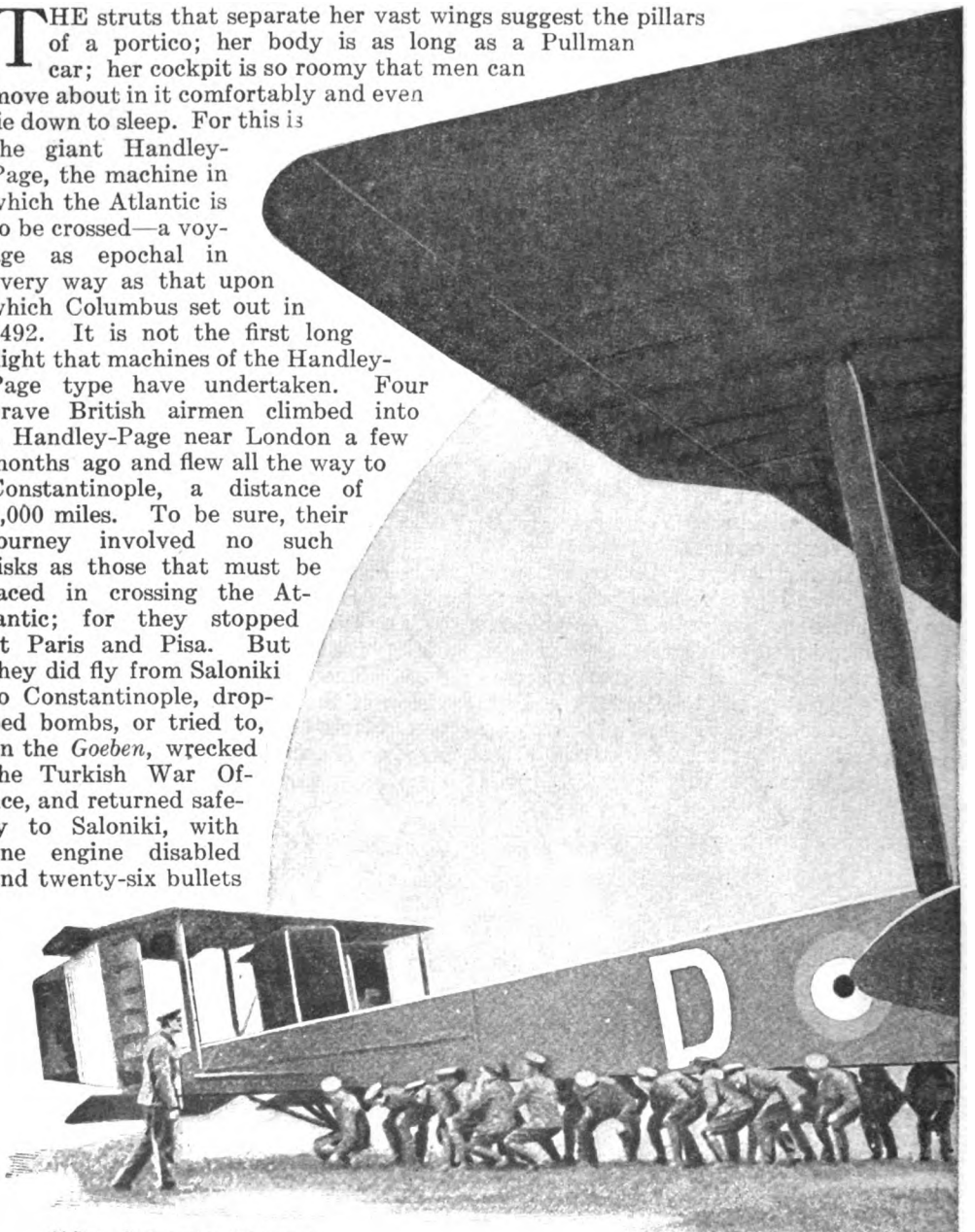
On Wings Across the Ocean to Fight

Giant bombing seaplanes which will travel to Europe in a day

THE struts that separate her vast wings suggest the pillars of a portico; her body is as long as a Pullman car; her cockpit is so roomy that men can move about in it comfortably and even lie down to sleep. For this is the giant Handley-Page, the machine in which the Atlantic is to be crossed—a voyage as epochal in every way as that upon which Columbus set out in 1492. It is not the first long flight that machines of the Handley-Page type have undertaken. Four brave British airmen climbed into a Handley-Page near London a few months ago and flew all the way to Constantinople, a distance of 2,000 miles. To be sure, their journey involved no such risks as those that must be faced in crossing the Atlantic; for they stopped at Paris and Pisa. But they did fly from Saloniki to Constantinople, dropped bombs, or tried to, on the *Goeben*, wrecked the Turkish War Office, and returned safely to Saloniki, with one engine disabled and twenty-six bullets



© Photos Underwood and Underwood

A great bird is the Handley-Page, which is to fly across the Atlantic. Her body, here held up by a company of men, is sixty-five feet long, her giant wings have a span of ninety-eight feet. She has two 12-cylinder Rolls-Royce engines

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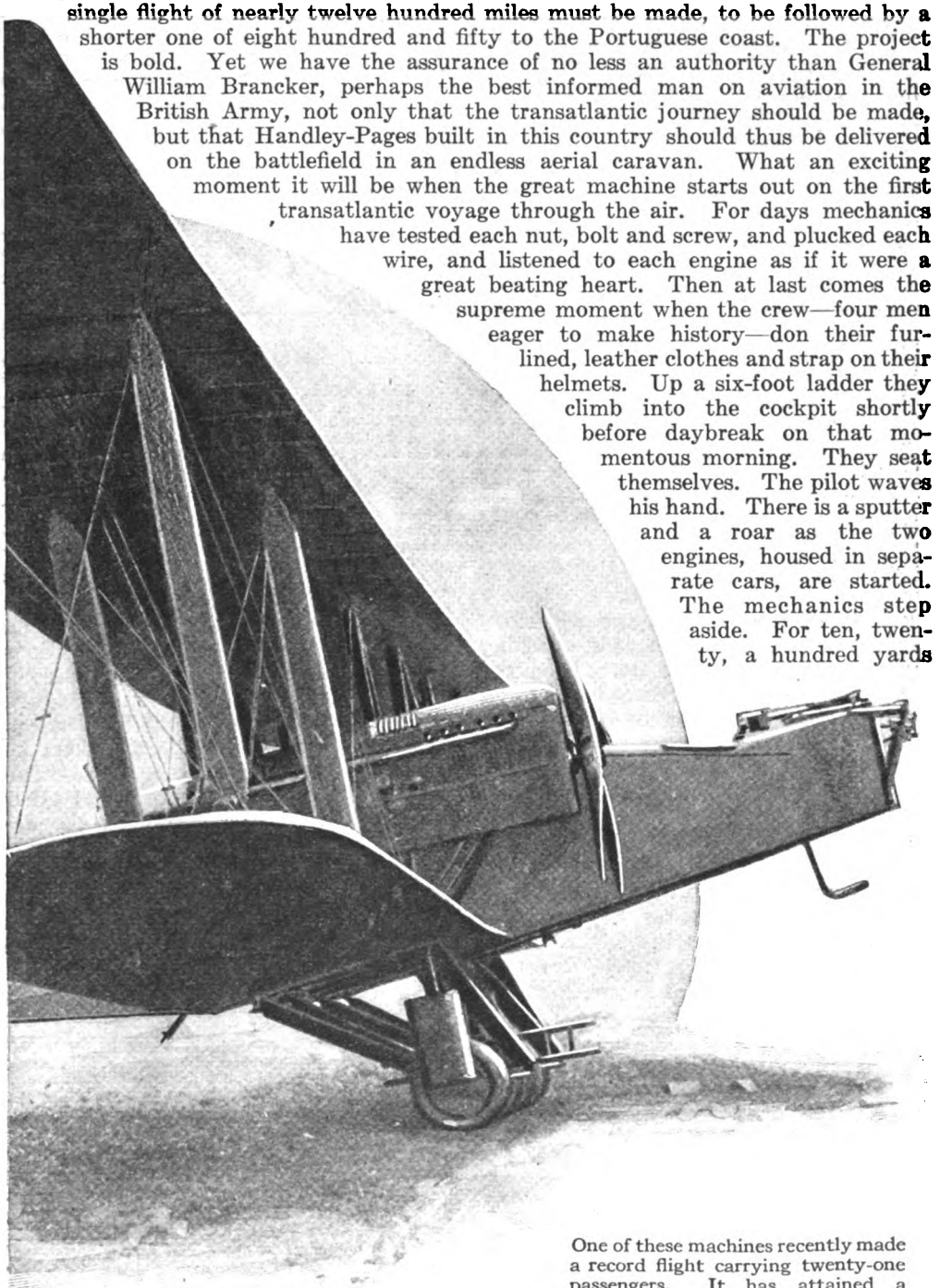
in their planes, after having covered six hundred and forty miles without a stop.

Now, the distance across the Atlantic is far greater than any seaplane, even the Handley-Page, has ever covered in a single stage. If the route to Portugal be taken and a stop made at the Azores—the route that seems to have most to commend it—a single flight of nearly twelve hundred miles must be made, to be followed by a shorter one of eight hundred and fifty to the Portuguese coast. The project is bold. Yet we have the assurance of no less an authority than General William Brancker, perhaps the best informed man on aviation in the British Army, not only that the transatlantic journey should be made, but that Handley-Pages built in this country should thus be delivered on the battlefield in an endless aerial caravan. What an exciting moment it will be when the great machine starts out on the first transatlantic voyage through the air. For days mechanics have tested each nut, bolt and screw, and plucked each wire, and listened to each engine as if it were a great beating heart. Then at last comes the supreme moment when the crew—four men eager to make history—don their fur-lined, leather clothes and strap on their helmets. Up a six-foot ladder they climb into the cockpit shortly before daybreak on that momentous morning. They seat themselves. The pilot waves his hand. There is a sputter and a roar as the two engines, housed in separate cars, are started. The mechanics step aside. For ten, twenty, a hundred yards



One of these machines recently made a record flight carrying twenty-one passengers. It has attained a height of over seven thousand feet

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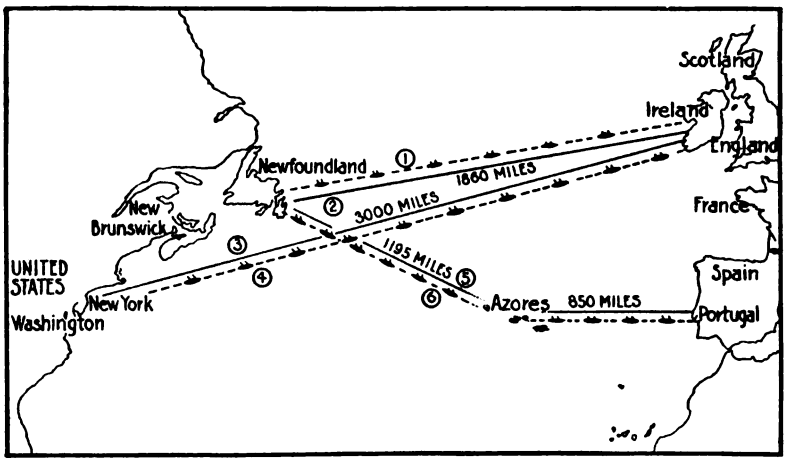

How to Get There on Wings

Route 1: The distance from Newfoundland to Ireland is 1860 miles. It could be covered in a seaplane which would be refueled every 300 miles from ships.

Route 2: If a land machine were used the distance from Newfoundland to Ireland would have to be covered in a single stage, which is possible now that such huge machines as the Handley-Page have been built, which can carry great quantities of fuel.

Route 3: Such is the fuel-carrying capacity of a Handley-Page or a Caproni that it could even fly the 3000 miles between New York and Ireland in a single stage; but it would have to be a land machine.

Route 4: A seaplane might be used to fly between New York and Ireland, the craft stopping every three hundred miles to take on fuel from ships.

Route 5: A machine could fly to Europe by way of the Azores. The distance of 1195 miles to the Azores could be covered in a single flight with a land machine. At the Azores the fuel tanks would be refilled and the craft would then fly to Portugal—850 miles.

Route 6: Seaplanes, taking on fuel from convenient ships, could fly to Europe by way of the Azores.

the machine runs over the water of Newfoundland—for she is a seaplane—dashing up spray as she moves on. Then the pilot gives her elevator ever so little an upward tilt, and she rises into the air like a huge seabird.

It is a gigantic machine indeed. The top plane measures ninety-eight feet from tip to tip. The length of the machine, including the tail, is sixty-five feet; its height twenty feet. The power is furnished by two twelve-cylinder "Rolls-Royce" engines of three hundred and seventy horse-power each. The fact that one of these machines made a record flight carrying twenty-one passengers and reaching a height of more than 7,000 feet gives an idea of its carrying capacity.

Of the four passengers, one is a navigator and one a mechanician; two are pilots. The pilots take turns at operating the craft; the mechanician keeps the machine oiled and in running order; and the navigator keeps the giant seaplane on its course.

Speed? Eighty-five miles an hour. But there is nearly always a twenty-mile current west to east, and the navigator avails himself of this when possible. Most of the flight is made at an altitude of about 5,000 feet. The men eat as the machine speeds on. They could sleep if they had any desire for sleep. But who could sleep? Besides, the journey to the Azores takes but seventeen hours.

Some time is lost by drifting, by the necessity of checking up location, especially after the sun goes down. But the instruments indicate the drift pretty accurately and keep the pilot on his course. The navigator works much as he would on board ship, except that his observations are less certain owing to the swiftness of the machine. Therefore, he makes good use of his wireless in getting his bearings as he nears his destination. When he sights a steamer, for example, he wirelesses her to get her location and other information. She flashes back the desired information. Knowing the steamer's position, he knows his own. He repeats this several times. He is also in communication with the great wireless stations in France, England, and the United States. A simple trigonometrical calculation based on their signals tells him where he is at any moment.

What's that ahead? The lofty Pico Alto, towering 7,500 feet above the Azores. The machine is 5,000 feet up. The pilot shuts off the engine. In another hour he glides down into the harbor. This first bombing-plane we have sent over has made the journey in less than a day. In another twelve hours the coast of Portugal is reached.

Suppose the machine had had to come down for repairs? Suppose there had

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been a storm and the water had been rough?

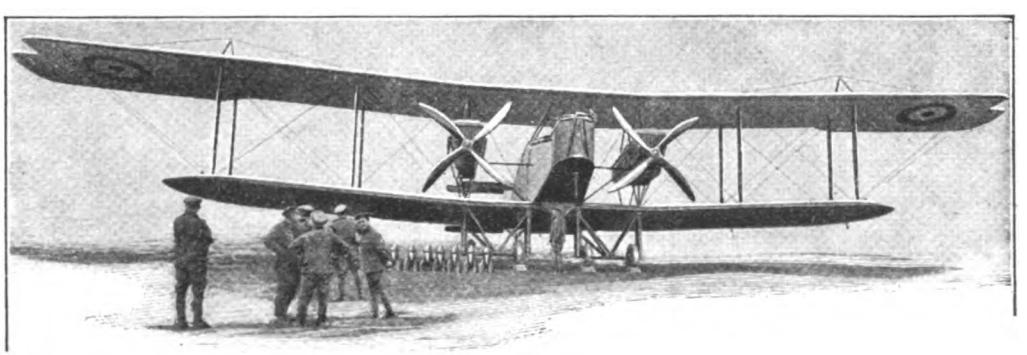
They might have drowned. For there is no possibility of rising in a seaplane from rough water. War is not a safe game under the best of circumstances. The man who flies across the ocean risks his life as much as the man who goes into battle. When you open your morning paper the day after the flight you will read comments on the difficulties encountered. Thus, one of the pilots will say:

"Meteorologic conditions were favorable, but we didn't worry much about this aspect of the flight. Military aviation has more and more outgrown the necessity of being dependent on meteorologic conditions. Only ten years ago an airplane couldn't fly if the wind blew. Now the warplanes fly through wind and a hail of bullets and shrapnel and keep on going after being hit as many as a hundred times. Lieutenant Colonel Rees of the Royal Flying Corps kept his machine going after it had been literally shot full of holes and after he himself had been shot through the leg and otherwise wounded.

"How much fuel did we carry? That was the least of our troubles. We calculated on one-tenth of a gallon per horsepower per hour. The machine had two 370-horse-power Rolls-Royce engines. That would make 1,295 gallons for the distance. This looks like a lot of weight, but these bombing-planes are specially designed to carry weight. They are weight-carriers and will be used to carry quantities of explosives, etc. On the flight over they use the space later to be given to explosives for excess fuel. We have never worried about fuel in making the flight."

And so a spectacular feat will give place to flight after flight across the ocean until the leaving of a plane from Newfoundland or New York attracts no more attention than the beginning of a steamer's trip for Liverpool. General Brancker sees no reason why the flying of heavy bombing-planes from America to Europe without wasting time or taking up much-needed ships' cargo space shouldn't be regarded as an eminently practical procedure. After the test flight, 10,000 of these bombing-planes are expected to go over as fast as they can be made ready for service. General Brancker believes that practically all the American weight-carrying machines will reach the battle zones by way of the air.

These giant planes will arrive at their destination a great deal lighter than they were when they started on their trans-atlantic voyage. They cannot carry bombs or any other war supplies because the large quantity of fuel they must have taxes their carrying power almost to the limit. Upon their arrival behind the fighting front they will be thoroughly overhauled and put into fighting trim. Then they will receive their full equipment of bombs and their guns will be mounted. After another try-out the monster machines will be ready to undertake long or short flights into the enemy's country, fully prepared to drop their big loads of explosives where they will do the greatest harm to the enemy. Each machine can carry approximately half a ton of explosives on each trip.



She will cross the Atlantic at a height of 5,000 feet and will land in Europe twenty or thirty hours after she leaves America. What an exciting moment it will be when she starts on the first trip!

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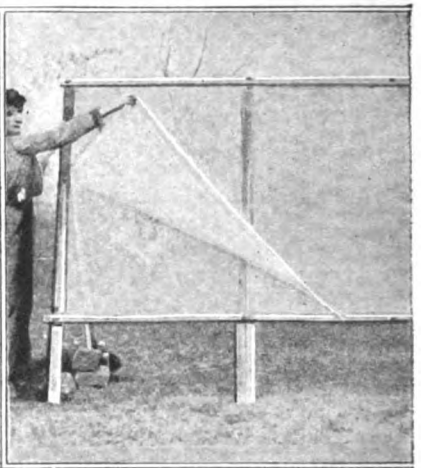
Housekeeping Made Easy

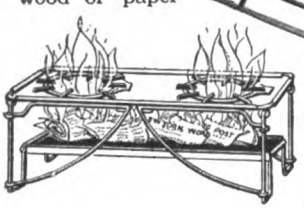
Novelcigarettecase. When you pull out the drawer the mouse starts toward the figure

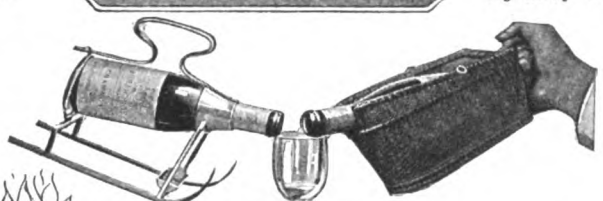
The new liberty mop has a wringing attachment which takes the drudgery away from mopping



With this stretcher two or sizes may be stretched

Folding camp stove with its fuel tray is shown below. It burns alcohol, wood or paper





The skate and the basket used as bottle holders for serving cooling drinks

In the center circle is shown a metal bracket to hold two dry cells for the door-bell circuit

A combination desk that has a phonograph at one end

A special pillow stuffed with horsehair that has been rendered sanitary, for the purpose of making a cooling head support for the baby

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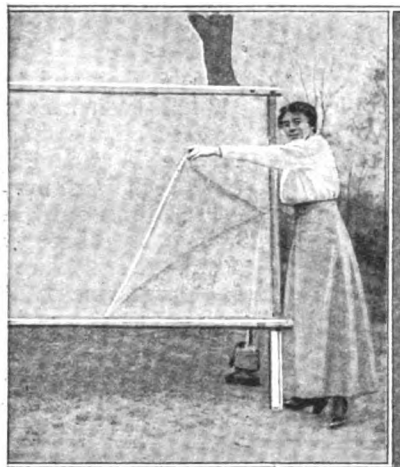
Housekeeping Made Easy



more curtains of various and dried at one time

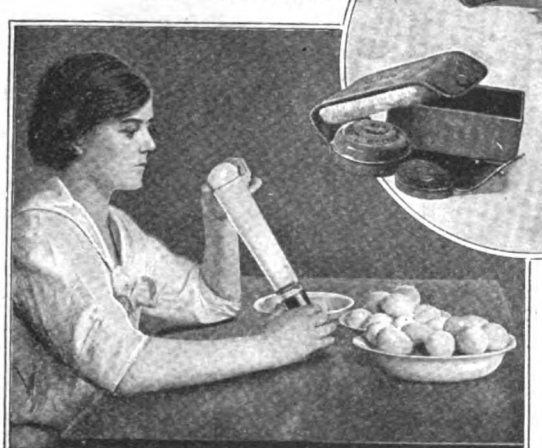
The vacuum cleaner shown at the right is run by muscle power

A cone-shaped wringer. The corrugations catch and clean the mop as the handle is twisted

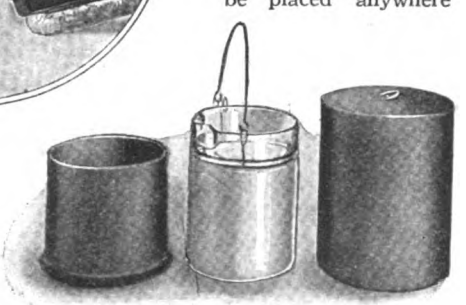
A knock-down tooth brush is shown at the right. It can be easily packed

For temporary holding of books or a flower pot this portable shelf may be placed anywhere

A shoe-shining kit put up like a safety razor. It is made of metal covered with real leather



A tube made of cardboard rolled to fit the end of a flashlight for candling eggs



A water cooler consisting of glass jar, zinc cover and non-conductive casing

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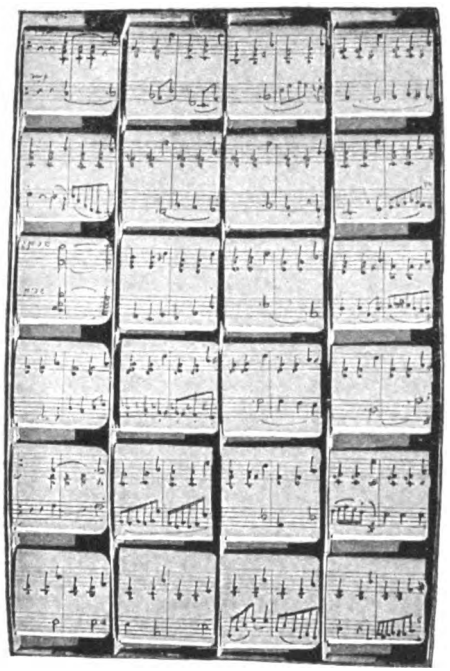
Turn a Knob and Become a Composer of Music

IT is possible for anyone to invent musical themes, provided he is able to read notes. A machine designed to aid in the composition of music and the playing of it as well has been invented by Arthur F. Blanchard, a member of the Massachusetts Legislature, in collaboration with Frank H. Grey, music composer.



This device enables the untrained person to compose and can his own music

The music machine resembles somewhat a sheet of music divided into small squares. There are six rows on each sheet, with four squares in a row and two bars of music in each square. Projecting from the sides of a box are the knobs of wooden spindles. Long strips of paper wide enough to contain two measures of music are wound about the spindles. In every section on each strip is a treble and a bass capable of harmonically uniting with any section immediately adjoining. As the paper strips are rolled and unrolled by turning the knobs on the spindles, the various sections are projected to the surface of the box as new squares.

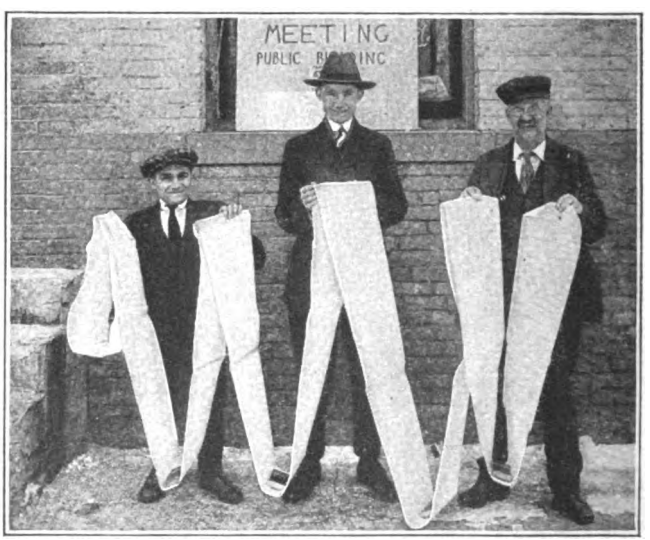
The device may be placed on the rack of a piano as if it were a sheet of music. The player has only to turn a knob to obtain the various combinations of melody. The composing can be completed by copying the notes.

No guarantee that anyone can compose an opera like the famous "Merry Widow," or even "Il Trovatore," goes with this music machine.

A Letter More Than Thirty-Eight Feet Long Without a Blot

A LETTER thirty-eight feet and ten inches in length has been sent to Frank Vaillancourt, a private in Company L, 104th Infantry, now in France, by his friends in Chicopee, Mass. More than fifty persons contributed to the letter, which was written in English, French and German. The German part was written by a native of Alsace Lorraine, who is now a loyal American. There was considerable variation in the handwriting, but the letter had no blots, although it was written in ink.

It is safe to say that the chronicle of home news and gossip of the town of Chicopee was completely exhausted to supply the material for this letter to its son in France.



It was a long, long letter that his fellow-townsmen sent to Frank Vaillancourt, serving with the colors in France

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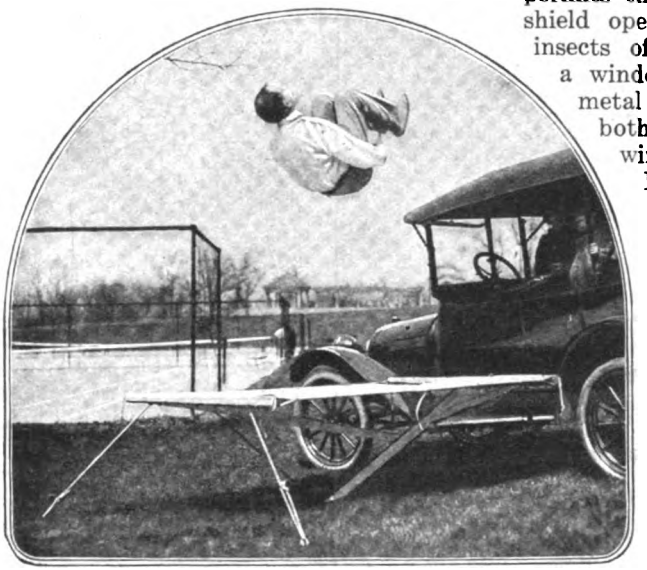
Discovered—A Cot that Doesn't Sag in the Middle

SLEEPING on a cot is an experience not likely to be enumerated among the pleasures of life. You lie down tired, and wake up next morning, if you have slept at all, more tired than ever. What's wrong? The cots. They sag in the middle when you lie upon them.



The inventor proves his confidence in his invention by turning a somersault on it from the roof of the car

But not all cots are that way. One has recently been invented that is unique. The heavier you are the less it sags.

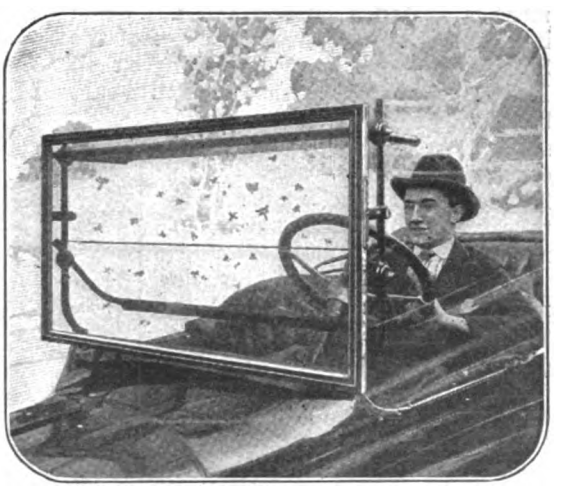
This remarkable cot, which is made in sizes to accommodate from one to six persons of average size, is intended as a portable tent bed for the use of automobile tourists. It can be folded up or put up in a few minutes, and is packed in a waterproof carrying case when not in use. The total weight of the complete outfit—tent, bed, and carrying case—is only ten pounds for each person accommodated.

The tent bed is put up against the side of the automobile, and is held down by ropes fastened to pegs driven into the ground, like the walls of a tent. The bed rests upon compound levers. The more you weigh, the more the canvas stretches.

Mosquito Bar for the Automobile to Keep the Bugs Away

A PRACTICAL new automobile accessory is a windshield screen which permits the motorist to keep his windshield open and still be protected from insects of all kinds. The device is a window-screen set in a wood or metal frame, which is attached at both ends to the uprights of the windshield.

Besides protecting the eyes of the driver from flying insects that would otherwise pass through an open windshield, the screen serves to keep the driver cool on warm summer days and to prevent the air suction in the rear seat when the windshield is closed. The screen also serves to diffuse the rays of the headlights of automobiles passing in the opposite direction at night, since the fine mesh of the screen breaks up the direct rays when the lights are not dimmed, as on country roads. The use of the screen makes it unnecessary to wear goggles, which, even when well fitted, are uncomfortable on a warm day or night. The advantages of such a screen are so obvious that, ere long, no motorist will go on tour without one.



At the same time you are protecting your eyes you can be adding to your bug collection

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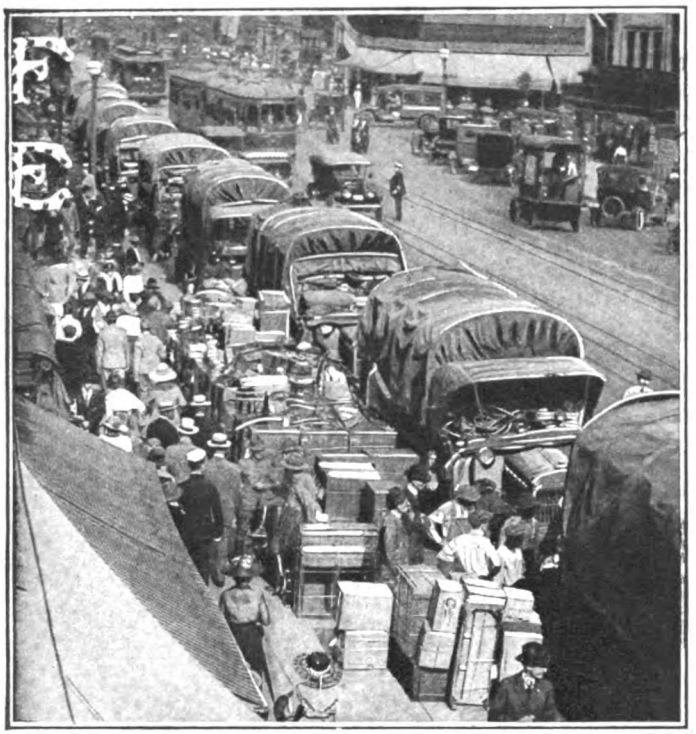
Moving Day for the Shipping Board Made Easy by Motor-Trucks

RECENTLY motor-trucks were employed to move the entire office equipment of one branch of the government a distance of 167 miles. When it was decided to move the office of the Shipping Board from Washington to Philadelphia, so that the workers would be near the center of the actual shipbuilding along the Atlantic coast, it was found that by the fastest railroad freight it would take from four to eight days to move the office equipment.



Some of the hundred and forty motor-trucks loading up for one of their trips between Washington and Philadelphia

Therefore, 140 of the army's new standardized three-ton war trucks, which on good roads can safely carry five tons, were called into service. They made each trip, carrying six hundred tons, in less than twenty-four hours, including the time of loading at Washington and unloading at Philadelphia.

Give a Spy-Glass and Help Sink a German Submarine

A PERISCOPE can hide as coyly as a periwinkle (though why periwinkles are coy we do not know), and something more than the naked eye is needed when you go hunting the U-boat. That is one reason why, when we began to turn out submarine-chasers by the mile and cut them off in lengths to suit, the Navy Department at Washington asked everybody to send in his, or her, pet spy-glass, telescope, field-glass, or whatever they had that might be useful in peering for periscopes. Another reason for the appeal is that the mark "Made in Germany" is on most of the better grade of field-glasses—the making of them before the war being almost a German monopoly. We are making better glasses all the time now, but the submarine-hunters can't wait, and so that "Made in Germany" glass of yours is needed if it is a good one.

The response to the Navy's call was first made last October. To date, the Naval Observatory at Washington has

Experts at the Naval Observatory testing glasses to see if they are fit for U-boat hunters

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accepted for use 31,000 glasses, and has returned 13,200 as unfit for use.

If you want to get your glass back, label it with your name and address. The department now has on hand more than a thousand unidentified glasses awaiting claimants.

Some of the glasses sent in are of great historic interest. One pair was used by General Grant at the Battle of the Wilderness; another, used on the Constellation in 1815, is still serviceable; and still another pair was the property of Captain W. T. Turner, commander of the *Lusitania* when she was torpedoed.

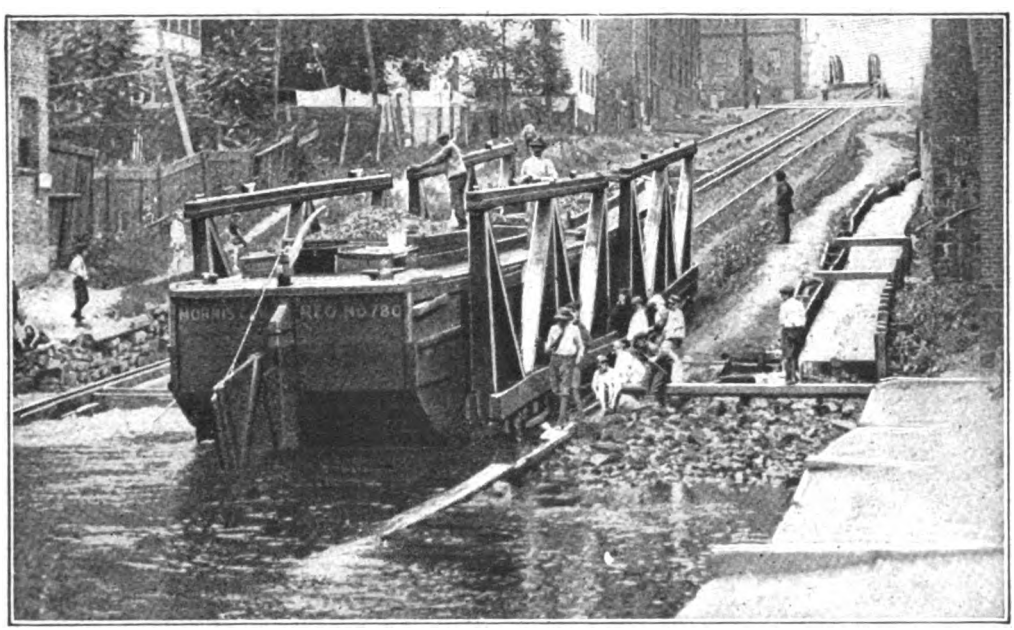
Canal-Boats that Climb Hills, and How They Do It

THE Morris Canal, which begins at Jersey City, winds its way leisurely through the State of New Jersey until it reaches Phillipsburg on the Delaware, where it connects with the Lehigh Canal system of Pennsylvania. The canal was opened in 1836, and was at one time a fairly important waterway for the transportation of coal from the Pennsylvania coal-fields. In recent years it was almost abandoned, but its use has recently been revived for carrying coal.

The Morris Canal derives its water from Lake Hopatcong. It is, without its feeders and branches, 102.38 miles long, and the highest point it reaches is 928 feet above sea-level. But in New Jersey also the water refuses to run up-hill, and to make it possible to reach the high level the canal is built in steps.

In order that the canal-boats may get from one level to another, inclined planes with cradle trucks on wheels are used. The cradle truck is allowed to run down into the water far enough to permit the canal-boat to float into the cradle. The cradle truck, carrying the canal-boat, is then pulled up the incline to the higher level, or lowered to the lower level down the incline, by means of a cable operated by a steam-winch. This primitive method was adopted, when the canal was built, at the suggestion of Professor James Renwick, then of Columbia College.

In the eastern division of the canal there are twelve such inclines, seven of them in Newark, which raise the boats about 720 feet; in the western division there are eleven inclines, which lower the boats about 690 feet. To overcome the rest of the grade, locks are used. The inclined plane shown in the picture is in the heart of Newark.



Since water refuses to run up-hill, the boats in the Morris Canal are carried up and down on cradle trucks drawn by a steel cable that is operated by a steam-winch

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Great Fortunes Are Thrown

Water, water all around, and yet the fire burns. Waste matter covers the Passaic River with a film of oil that needs only a carelessly dropped match to turn it into a river of flame

PRODIGAL RIVER runs through the Land of Waste and empties into the Bay of Squander. Whenever its castaway riches of chemicals, gases, oils, and gums catch fire, its economic sin is proclaimed throughout the country.

The last spendthrift carnival occurred not very long ago, when someone set fire to this stream of extravagance—the Passaic River. Where the fire originated, the water is still covered with an iridescent inflammable scum. This coating is made up of refuse from petroleum refineries at Bayonne, which is borne in on the tide to mingle with the greasy discharge from Newark, Paterson, Passaic, and other industrial communities of the valley. On the river drift waxen floes of paraffin. Along shore the piers and piles reek with the strong smell of crude oils, and the rocks are slippery and stained from the wastage of rendering-tanks. The gas plants of the cities contribute their quota in coal-tar and liquors charged with chemicals, while every factory releases polluting waste products.

Millions Lost in Silk Industry Alone

A persistent contributor to these foul deposits is the city of Paterson, center of the silk industry of the United States. The coloring from one pound of silk will spoil

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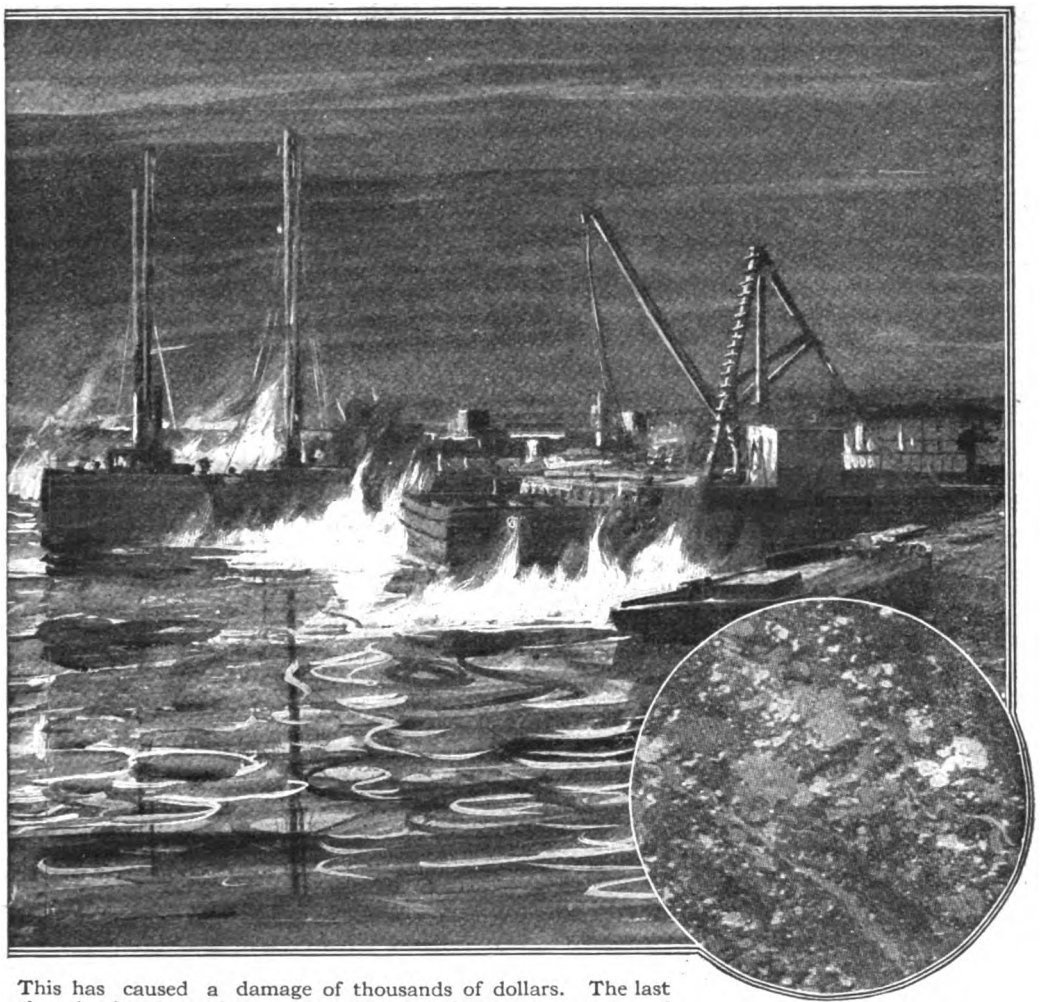
Away on River that Burns



This has caused a damage of thousands of dollars. The last time the river burned vast stores of war munitions were threatened

Not a study of the Milky Way, but a "close-up" of the Passaic River. The spots and blotches are waste products representing an enormous fortune

a thousand gallons of water and inflict 2.05 pounds of solid waste upon the ever-patient Passaic.

The composition of these wastes was carefully investigated, not long since, by Dr. George C. Whipple, of Harvard University, who was retained by the Committee on Sewage Disposal of the city of Paterson. From 25 to 35 per cent of the weight of raw silk is a gum that must be washed away before the fibers are twisted and wound in the operation known as silk-throwing. This gum contains about 17 per cent of nitrogen, which could undoubtedly be utilized for many purposes. The throwsters, in cleaning the silken threads, use at least 5 per cent of the weight of the fibers in soap — the latter containing at least 60 per cent of refined vegetable oils. Making allowances for those manufacturers who recover at least 75 per cent of this soap, the amount of soap daily wasted by the dye-works of Paterson is 13,300 pounds, of which 8,000 pounds represent fat.

Scores of the products of the laboratory are employed in giving the varied shades to the fabric of fashion and luxury.

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Some manufacturers use their dye-baths over and over, adding new coloring from time to time to keep up the strength. Logwood and the anilines are the chief constituents of the contents of the vats.

The tinge of the Passaic is largely due to the presence of discarded sulphur black thrown out of solution, although at times the sewage from Paterson has a purple or violet color when an unusual amount of expensive coal-tar products has been permitted to escape. The mills were glad to pay a dollar a pound for sulphur black not so many months ago, and at the present writing dyes in fancy colors are quoted at from eight to nine dollars. Undoubtedly millions of dollars have been lost from the waste of silk factories alone.

Wastes Now Being Eliminated

Pressure of legislation, State and Federal, has made the captains of industry along Prodigal River and all other waterways see new light on an old problem. They are now realizing that they have been wasting their substance in riotous living. Coincident with the investigation to determine whether or not there shall be inserted a clause in the Rivers and Harbors Bill excluding the discharge of free acids from all navigable streams above tide-water, the chemical-makers are finding that hydrochloric acid can be combined with lime and turned into a valuable disinfectant. Paper manufacturers are saving their sludge and selling a score of by-products derived from it.

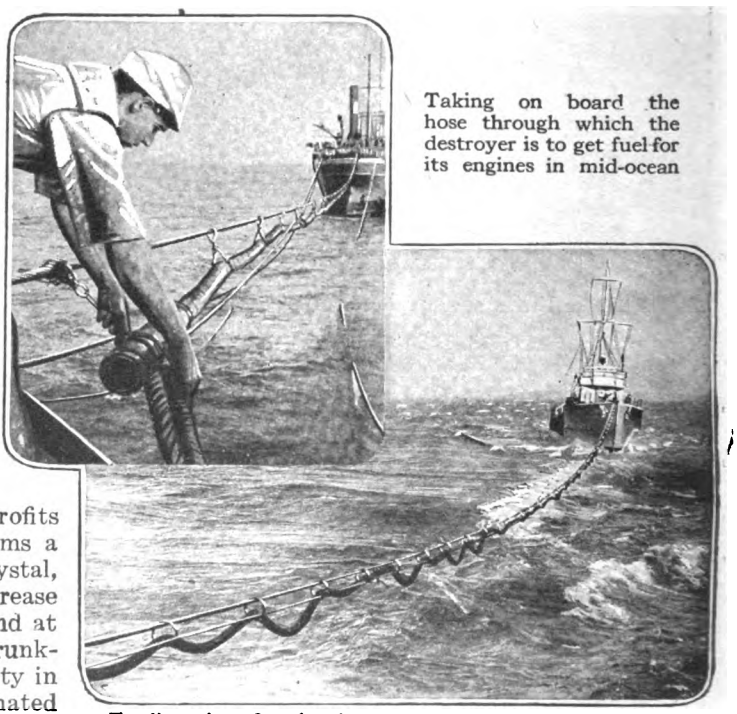
Even the municipalities, so often beholden to nobody, are reaping profits by turning into the streams a treated sewage clear as crystal, divested of a garbage grease worth fifteen cents a pound at war prices. The new trunk-line sewer that is to empty in New York harbor is estimated to cost $11,000,000. This could be met in fifteen or twenty years from soap waste alone.

Piping Oil from One Pitching Ship to Another at Sea

THE bunkering of sufficient fuel is a serious problem for ships of comparatively small tonnage starting on long cruises. Under war conditions, it becomes necessary to supply the ship with fuel from another ship at sea.

Transferring fuel from one ship to another while both are on the high sea has been a difficult problem to solve. To convey the fuel in bags or barrels by means of a cableway suggested itself; but it was found that this plan was not feasible when both ships were pitching in a heavy sea.

The success of the cableway method was made possible by the invention of the automatic tension engine patented by Mr. Spencer Miller, a noted American engineer. This engine maintains a constant pull on the steel cable connecting ships; it winds the slack upon a drum, and pays out more cable when the pitching of the ships, which are kept at a safe distance of 400 feet, increases the tension.



Taking on board the hose through which the destroyer is to get fuel for its engines in mid-ocean

Feeding time for the destroyer, which, being a bottle baby, is getting its ration of oil through a hose stretched along a cable to the mother ship. The cable also tows the destroyer, automatically giving or taking up slack

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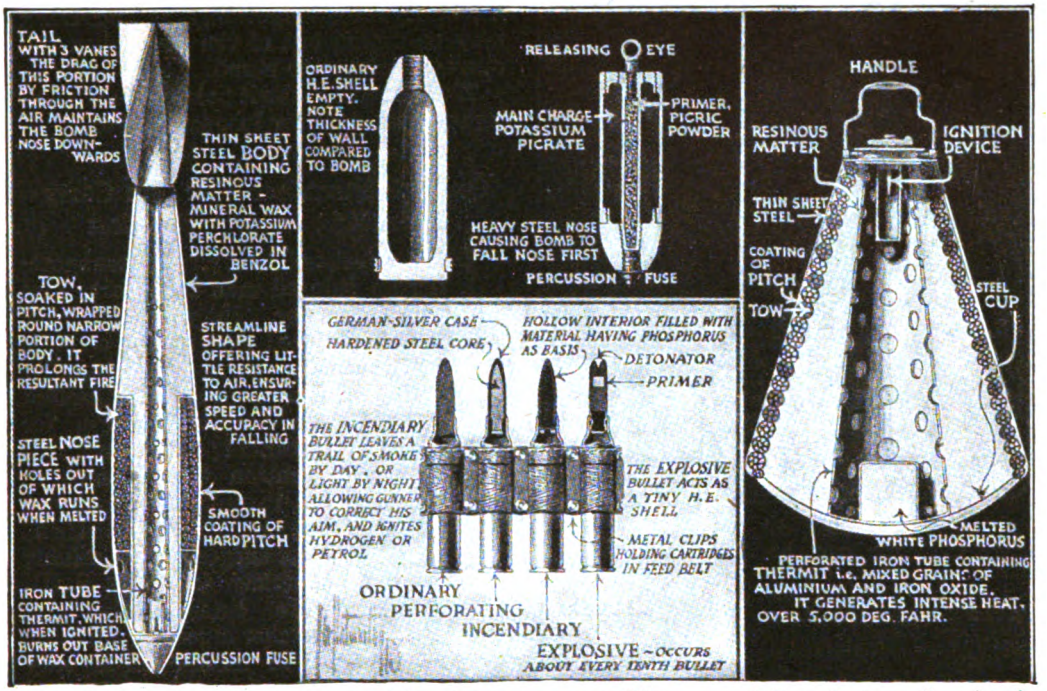
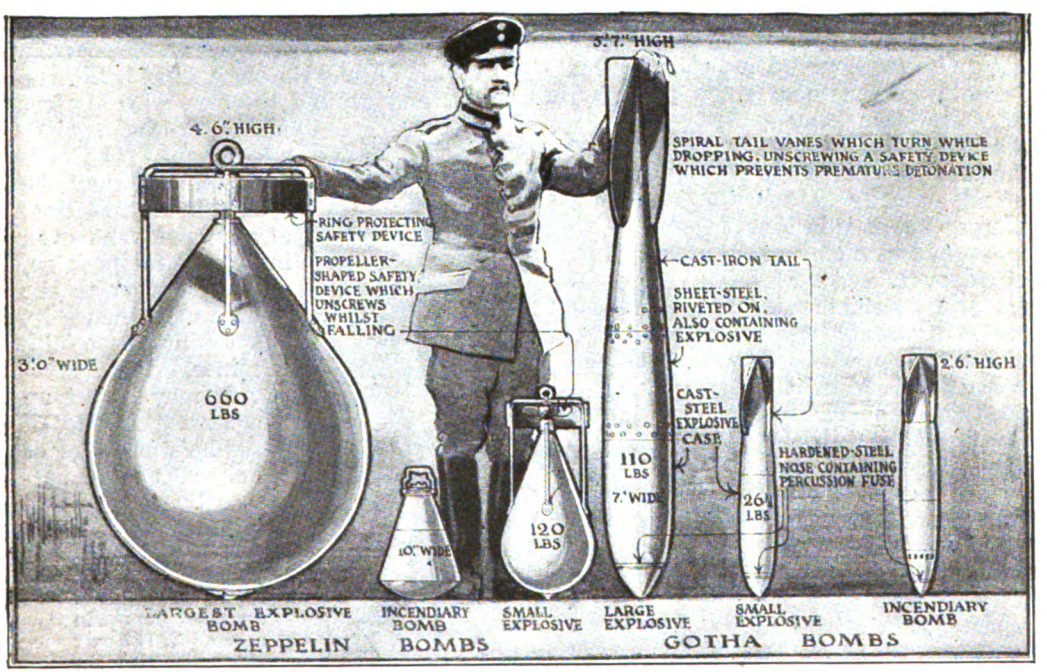
The Death that Drops from the Skies



A Gotha incendiary bomb — Aerial machine-gun ammunition Above—an explosive bomb of early type — A Zeppelin incendiary bomb



"There was another air raid on London last night." What that familiar announcement means may be read in these pictures, which show every type of bomb and bullet that is being used by the Germans. Do not be misled by the appearance of the propeller-like tails. There is no such thing as an "aerial torpedo." All bombs merely fall through the air; none has been invented that is self-propelling

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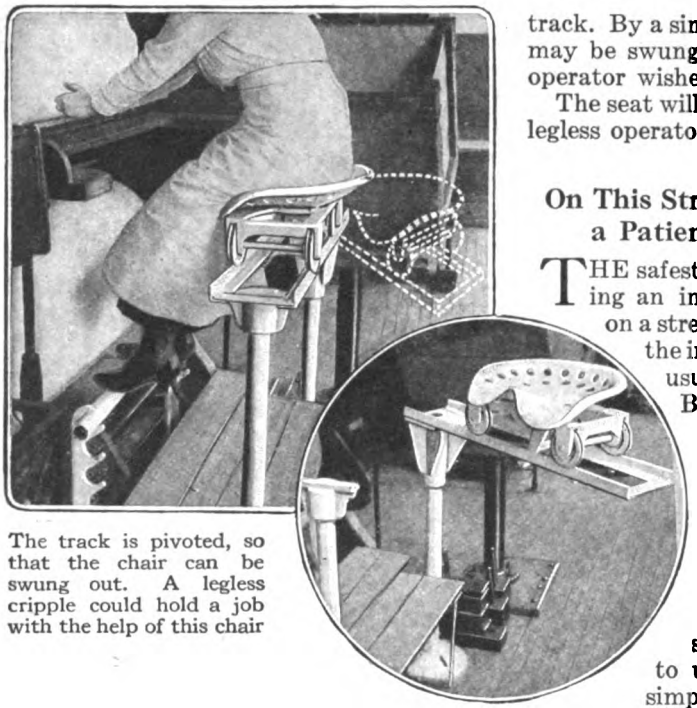

The track is pivoted, so that the chair can be swung out. A legless cripple could hold a job with the help of this chair

The Sliding Chair—It Reduces Fatigue in the Factory

LONG before the true interrelations between economy and efficiency were generally understood, some pioneers in scientific management reached several important conclusions. They found, among other things, that it is in the interest of economy or efficiency to keep workers and machinery in the best possible condition.

Mr. R. C. Marshall, of Troy, N. Y., has recently invented and placed on the market the fatigue-eliminating seat shown in the pictures above.

The seat is specially intended for inspectors in paper and cloth mills. It is so shaped as to insure a normal posture of the sitter. It slides from side to side on wheels running on a track. By a single motion, seat and track may be swung out of the way when the operator wishes to stand.

The seat will make it possible to employ legless operators for inspection work.

On This Stretcher You Can Carry a Patient in Any Position

THE safest and best way of transporting an injured man is to carry him on a stretcher. The stretcher, with the injured man resting on it, is usually carried horizontally. But suppose space is limited—a narrow passage, for instance? It is just this situation that is met in an invention introduced by Dr. F. E. Clough, chief surgeon of a mining company in Lead, S. D. He has devised a stretcher especially adapted to use in mines. It is very simple, and has demonstrated its merits so satisfactorily that it has won the approval of the United States Government.

The patient is strapped to the narrow stretcher around the chest, hips, below the knees, and around the feet, with his feet firmly resting against a footboard. The loaded stretcher may be carried in any position, at any angle, and even in a vertical position, without danger to the injured man; hence its adaptability especially in mines.

It may be set up against the side of the hoisting cage or hoisted to the surface by a rope and pulley.

A new kind of stretcher for use in mines. Without the patient it looks like an ironing-board with straps and a footboard. It has handles at the sides and head end

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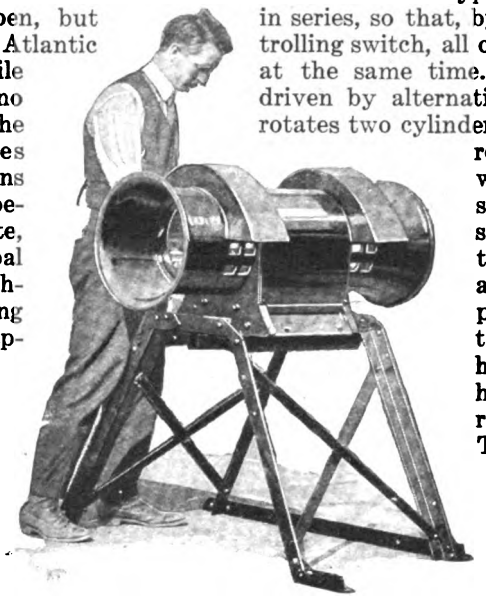
Big Sirens to Warn New York of Air Raiders

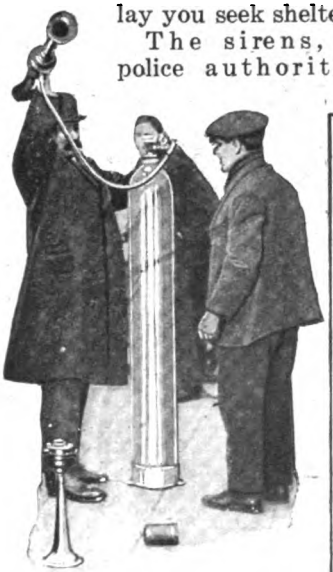
IT may never happen, but an attack on the Atlantic coast cities by hostile air raiders is by no means impossible. The military authorities have provided means of defence that are believed to be adequate, and the municipal authorities are furnishing means of warning the people of the approach of air raiders.

Imagine yourself in New York on a fateful day which, let us hope, will never come. You may be in your home, in church, in one of the sky-scraping office buildings, or on the street. Your thoughts are far from air raids. Suddenly you stop. A shriek, unearthly and indefinable, fills the air. You know what it means, and without delay you seek shelter.

The sirens, which the police authorities of New York have placed on the roofs of buildings throughout the city, are of the electrical type. They are wired in series, so that, by throwing in a controlling switch, all of them are set going at the same time. An electric motor, driven by alternating or direct current, rotates two cylinders at the rate of 3,500 revolutions a minute within perforated sleeves. The shrieking sound is produced by the vibrations of the air passing through the perforations in the rotating cylinders, as the holes move past the holes in the sleeves surrounding the cylinders. The greater the speed, the higher the pitch of the sound. The shriek of these sirens can be heard a distance of three miles if the conditions are favorable.



New York sirens produce sound with air passing through perforations in fast rotating cylinders



In Paris, sirens connected with compressed-air tanks are used; they are placed at the street corners

Paris Is Now Making Even Its Cellars Bomb-Proof

WHETHER it be a cyclone or a bombing raid, the safest place in time of danger from the air is the cellar. So, when the siren shrieks its warning in Paris, the people seek safety underground.

Once in a while, however, a shell bursts just outside and death-dealing pieces rain through the cellar windows. Therefore, orders have been issued to bank the windows with sand-bags—orders that the Paris police make sure are carried out. The man in the picture is substituting a sturdy stone barricade for the sand.

© International Film

Stone walls do not a prison make, but they'll help keep bursting bombs out

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Diving for Millions in a Giant Bell

After the war there will be a rush for the fortunes lying in torpedoed ships at the bottom of the sea

DO you want a fortune that would make John D. Rockefeller jealous? It's easy. Just invent a sure means of raising the great fleet of torpedoed ships that lie in comparatively shallow water.

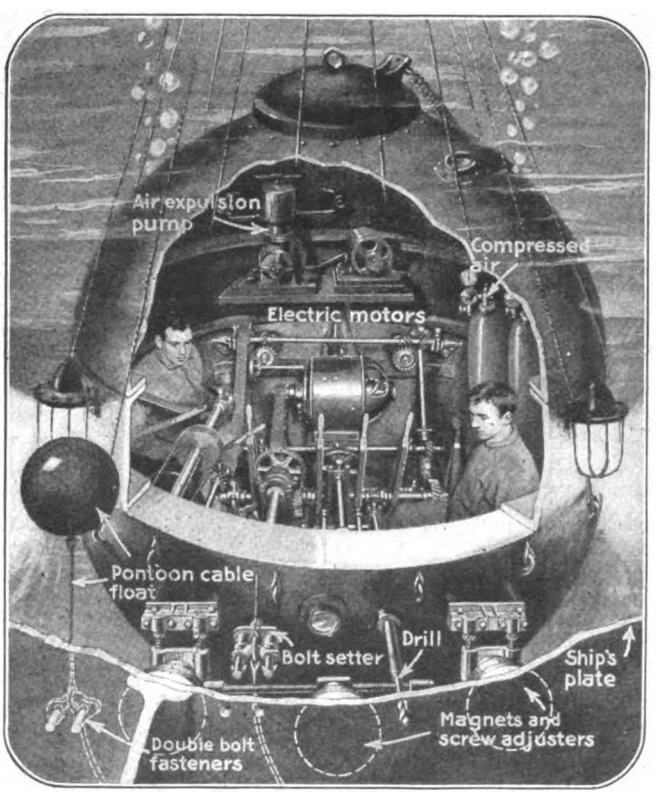
But you'd better hurry. Here's W. D. Sisson, of Los Angeles, Cal., already in the field with a huge diving-bell with which he plans to raise ships by an up-to-date application of the pontoon method.

After the pontoons—great cylinders of steel—have been filled with water and sunk alongside the ship, a diving-bell—built with a heavy cast-iron shell, spheroidal in shape, with a water-tight manhole at the top and a number of glass windows, strongly built to withstand pressure—is lowered. It has working space for a crew of two men, and is equipped with electric motors, a pump to force out foul air, pure-air tanks, drills, powerful electric magnets, machinery for lifting and lowering, and steering propellers.

The electric magnets hold the bell against the ship's side, while drills, worked from the inside of the bell, bore a series of holes in the sides of the vessel. Into these holes a magnetic bolt-holder thrusts expansion bolts fitted with staples, to which are attached cables leading from the pontoons. This does away with the operation—always difficult—of passing chains under the ship's hull. The free ends of the cables are made fast to floats which buoy up the pontoons. An ingenious detail is the adjustable centering of the drill-holes by means of the screw-shaft magnet supports, which are rotated from within the shell by power shafts, and thus move the shell bodily relative to the magnets.

After all the bolts have been fastened, the water is pumped out of the pontoons by electric motors and air is forced in to take its place. Then the pontoons rise, and, by their combined pull, the ship is brought to the surface — provided there has been no hitch in the work. Easy, isn't it?

Underwater operations are clearly visible to the crew through the portholes. Communication with the tender is provided by telephones.



Two men from the inside of this balloon-shaped diving-bell fasten pontoons to the sunken ship, which is then raised by the buoyancy of the pontoons

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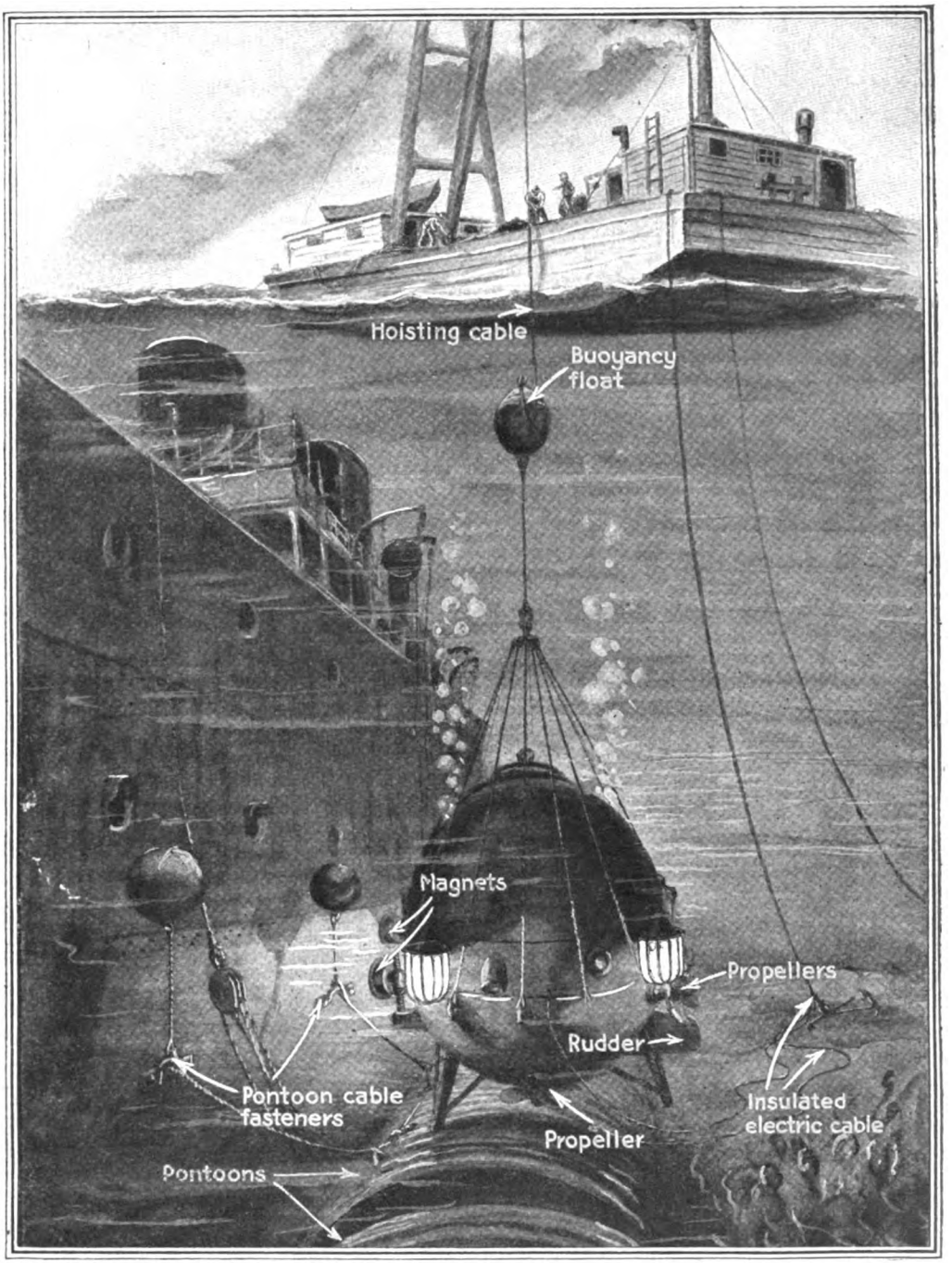
A Machine-Shop Under Water



This ingeniously devised diving-bell merely serves the purpose of fastening the lifting pontoons to the sides of the ship by means of staples bolted to the iron plates of the hull. Magnets are used to hold the diving-bell against the side of the ship, to drill the holes for the staple-bolts, and to hold the bolts while they are forced into the holes. The power for the motors that drive the machinery and for energizing the magnets is supplied by generators on board of the tender, as are also the arc lights. Compressed-air receivers, with a pump for expelling foul air, provide fresh air for the crew. Telephones furnish communication with the tender

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An Airmen's Dictionary

Just as Tommy in the trenches uses terms of his own invention, so have aviators of the American and British air services made their own vocabulary

Above: A "blimp," that is, a dirigible balloon from which is suspended a car shaped like an airplane fuselage

The drum of the Lewis machine-gun. As rapidly as one drum is emptied another is substituted

ACK EMMA—Air Mechanic.

ADVANCED ECHELON — Aircraft park. Headquarters of fighting squadron and also reserve airplane section.

BASE ECHELON — Aircraft park. Headquarters of squadron back of lines.

BLIMP—A dirigible balloon from which a car shaped like an airplane fuselage is suspended.

BOUNCE.—Bad landing, causing the airplane to bounce; often the cause of a crash.

BUMPS.—Irregularities in the atmosphere, causing the airplane to rise or fall.

BURST.—The firing of a drum (forty-seven cartridges) from a machine-gun (usually a Lewis) in the air.

COLLISION FIRING.—Shooting at an enemy airplane flying in the same direction with the object of placing the shots where the enemy will run into them.

CONTACT.—The closing of the ignition switch controlling the engine of the flying machine.

DUAL.—A flight in which two aviators go up in the same airplane.

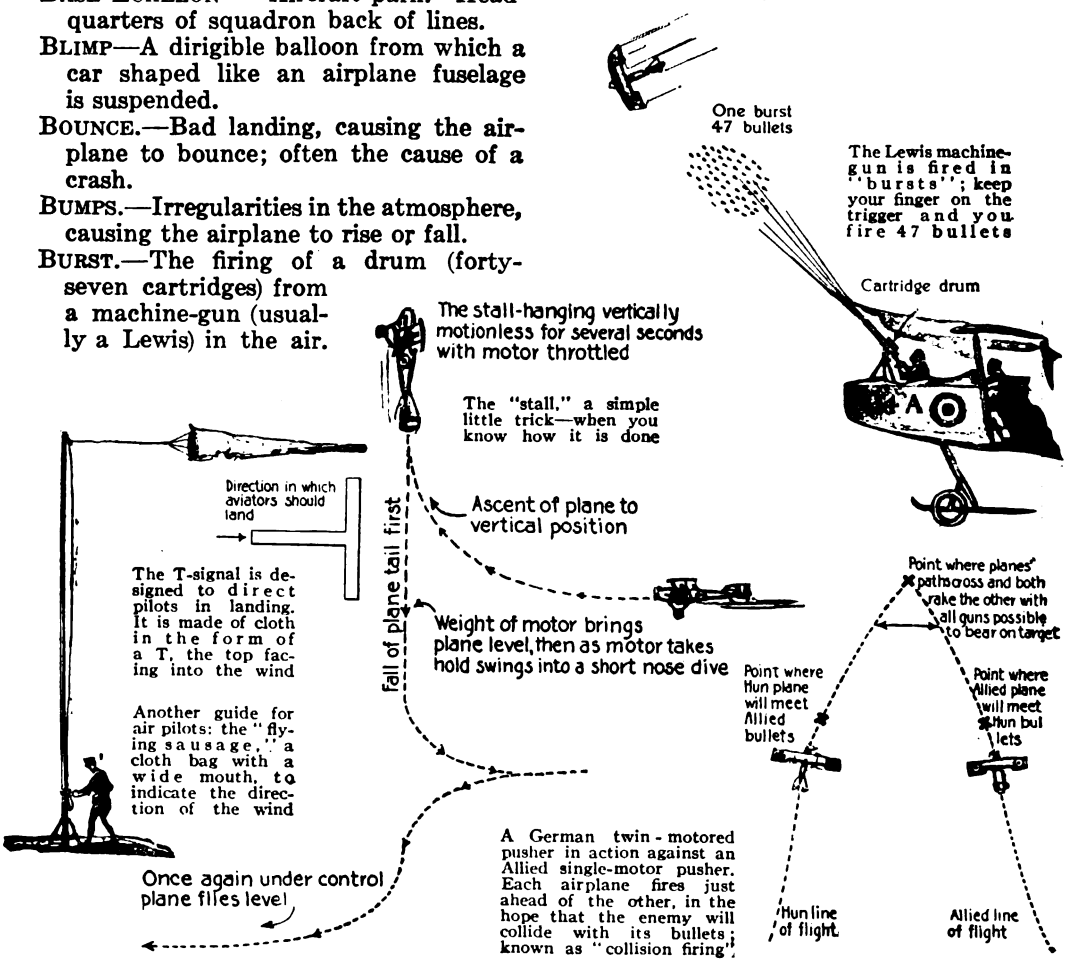
F.L.—Flight Lieutenant.

F.O.C.—Flight Officer Commanding.

FLYING SAUSAGE.—Long cloth bag flown from pole to show direction of wind.

F.S.—Flight Sergeant.

F.S.C.—Flight Squadron Commander.



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GIVING HER THE GUN.—Advancing the gasoline control lever so as to turn on the gasoline.

HUNGRY LIZZIE.—Ambulance stationed at flying field.

JOY-STICK.—One of the controls of a plane —worked by the hand.

KISSING THE EARTH.—A crash in which the airplane stands on its nose.

ONE-WINGER.—Observer, who wears a one-wing badge on his uniform.

PANCAKE.—Falling of airplane flat to earth after losing flying speed.

PILLS.—Small hand bombs used for attacking Zeppelins or Balloons from the air.

PROP.—Propeller.

PROP-STICK.—Cane made from a damaged propeller.

RUDDER-TAPPER.—Cross-wind encountered while machine is in flight.

SITTING ON HIS TAIL.—The operating of an airplane so that it maintains a course just above and back of an enemy plane, allowing the Allied pilot to shoot away the Enemy plane's controls.

STALL.—The operating of the controls so as to cause the plane to rise in the air and hang vertically motionless for several seconds.

SUCK IN.—The turning of the propeller by a mechanician while the plane is on the ground, causing the gasoline to be sucked into the cylinders.

T-SIGNAL.—Used to indicate right direction in which airplanes should land.

TAXI.—The operating of a plane so as to drive it over the ground without rising into the air.

TRACERS.—Bullets used in aerial fighting whose smoky course can be seen when fired, to assist in scoring a hit.

TWO-WINGER.—A pilot, who wears the R.F.C. two-winged badge.

UPSTAIRS.—Up in the air.

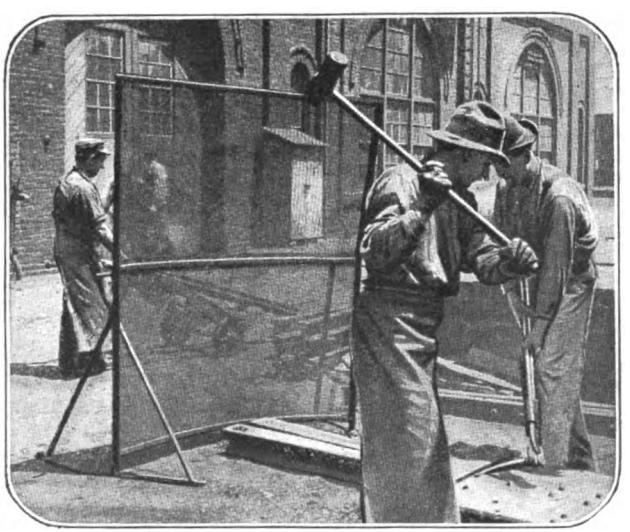
W.C.—Wing Commander, an officer in charge of several squadrons.

WING-TIP FLARES.—Magnesium lights placed under the bottom planes of night-flying airplanes, used only for landing at night.

ZOOM.—The operating of a plane so that it flies up and down like a roller-coaster.

Safety First Wherever the Rivet-Heads Fly

THE commonest method of removing rivets is to cut off their heads with chisel and hammer, and then to punch them out with some appropriate tool. In railway shops and other establishments, where a great many rivets have to be removed, the flying rivet-heads have always been a source of actual danger to the employees working near the place where the rivet-heads were chiseled off. In the shops of the Southern Pacific Company in Sacramento the number of accidents from that source has been greatly diminished by the use of a portable screen, which is shown in the accompanying picture. It is set up wherever rivet-heads are cut off and can easily be moved from one place to another.



The heavy wire screen will stop flying rivet-heads and prevent them from causing injury

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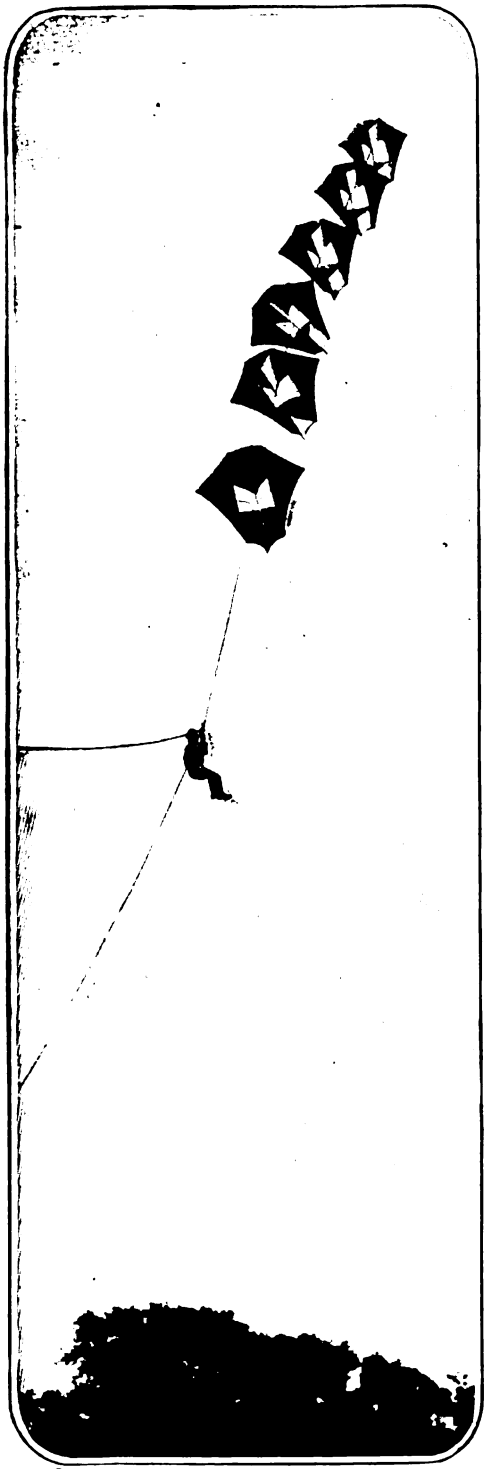

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What's he doing up there? Oh, merely taking pictures of the enemy's country

Using the Man-Lifting Kite to Watch the Enemy

IN England, and also in the United States, experiments were made long before the war to test the utility of man-carrying kites for making observations and taking photographs. The use of kites for observation purposes was suggested and tried in England by Colonel Cody (not "Buffalo Bill," but another American) years ago. For many years kites were used in the United States and in other countries to carry instruments for meteorological observations to high altitudes; but balloons are preferred for war service, because they have greater lifting power and are easier to control.

Experimentation with kites has been revived in England, those used being from nine to twelve feet high and approximately the same width. Two kinds of these kites are flown. In light winds kites are used that present a solid surface; in strong winds, kites of the kind shown in the picture, with square openings in the middle. As a rule, a relay of smaller pilot kites is sent up, followed by the large and strongly built lifting kites.

The relays are attached to piano-wire or ¾-in. Manila rope. Such is the pull of the kite relays that in a strong wind it takes from fifteen to twenty men to hold the line. Swiveled winches, operated by gasoline engines, have recently been substituted for man power. The kites are built from the best spruce wood and canvas, like the wings of an airplane.

Oxidizing Carbon to Make a Powerful Explosive

IF liquid oxygen is combined with carbonaceous material in the proper proportions, it will make an explosive powerful enough for industrial use. The Germans, under stress of necessity, have already done this, and the United States is now conducting experiments along the same lines. Mr. George S. Rice, of the Bureau of Mines, who is in charge of these tests, is using for this purpose a cheese-cloth container holding a mixture of carbonaceous substances, which is then dipped into liquid oxygen fifty-five per cent pure. This oxidizes the carbon with sufficient suddenness for detonation.

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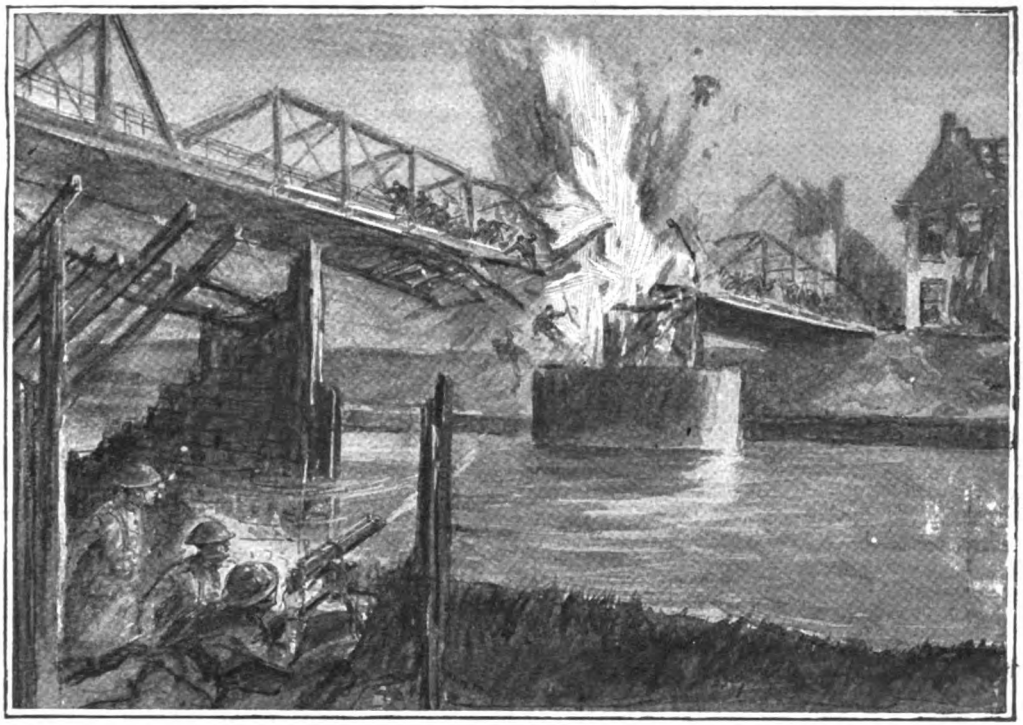

On the Germans came, rushing madly upon the bridge. A whole platoon had almost reached the center when the American marines' bullets reached the mine

Marines' Bullets Win in Race with Death

An incident in the recent German drive toward Paris

IT was in the early stages of the recent German drive toward Paris. At Chateau-Thierry, a small town on the Marne south by west of Rheims, American marines formed part of the Allied line. One-third of the town is north of the Marne, two-thirds are south, and a single bridge connects the two sections. The Americans, with their machine-guns, occupied positions in the northern part of the town. To cross the Marne at this point, the enemy must use the bridge at Chateau-Thierry.

The American marines massed their guns around the north end of the bridge. In case they should have to fall back to the other side of the river, they mined the bridge by placing a quantity of powerful explosives beneath the structure; the detonating wires were controlled from the south side of the river.

Wave after wave of German soldiers advanced toward the Chateau-Thierry bridge. The American marines fought bravely, but finally the avalanche of the enemy's troops compelled them to withdraw to the southern bank. The time had come to blow up the bridge to prevent the enemy from crossing; but, when the order was given, the detonating wires failed to work. They had been severed by the enemy's fire.

At once the marines were ordered to concentrate their machine-gun fire on the explosive charge under the bridge. Several guns were trained on the mine, and luminous bullets were used, since darkness was rapidly falling.

On came the Germans, rushing madly upon the bridge under the fire of the Americans. A whole platoon of German troops had almost reached the center of the bridge, when some of the American bullets reached the spot. There was a terrific explosion, and down went the bridge with its load of enemy soldiers.

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When You're Ready to Peel Those Fresh-Water Pearls

WHAT is the man in the accompanying picture doing? Wearing two-story eye-glasses, the four lenses of which form a combination equivalent in power to a low-power binocular microscope; and, armed with a sharp knife, he is peeling a fresh-water pearl. It requires a steady hand and a sure touch to do the peeling properly, and the success is always a matter of chance.

A pearl is built up in layers, like an onion. The layers are very hard, but with sufficient skill one layer after another may be removed or "peeled."

Sometimes a pearl that appears dull, spotted, or imperfect in shape, when peeled yields a pearl of the finest luster and, consequently, of great value. Dull, rough pearls, bought for a few dollars, are sometimes sold for many hundreds of dollars after having been peeled.

But the success of the operation is uncertain. Not always does the peeling improve the appearance and value of the pearl. If the knife of the peeler should slip, and in penetrating the outer layer scratch the inner layer, that scratch would destroy the value of the pearl, no matter how beautiful the luster revealed by the peeling might be.

The nose microscope shown in the picture is a valuable aid in the business of peeling pearls, and saves many a day that might otherwise be wasted.

He wears two-story eye-glasses—a kind of nose microscope—and he is peeling a pearl with their aid. If his knife should slip he might lose a small fortune

Are There Potato-Bugs in Your War Garden?

"IF the vacuum cleaner will suck dust off the floor, it should pick the bugs off the potato plants in my garden," reasoned Mr. Stanley Smith, of Cincinnati, and proceeded to put his theory to the test. Like many other suburbanites, he was trying to raise potatoes in his back lot. So far, all he had raised was a fine crop of potato-bugs.

Mr. Smith attached a long extension feed wire to a lamp-socket in the cellar of his house, carried his vacuum cleaner to the potato-patch, and connected it with the feed wire. The current was turned on, and the success was beyond all expectation. In a few minutes Mr. Smith, assisted by his daughter, had more than a thousand potato-bugs in the bag of his cleaner.

Nothing easier than this method of picking off bugs from your potato plants. Try it and be convinced

Only five days left in which to mail your contribution to the "Helping Out the Farmer" Prize Contest, announced in the July number. Send it along—you may yet win the First Prize.

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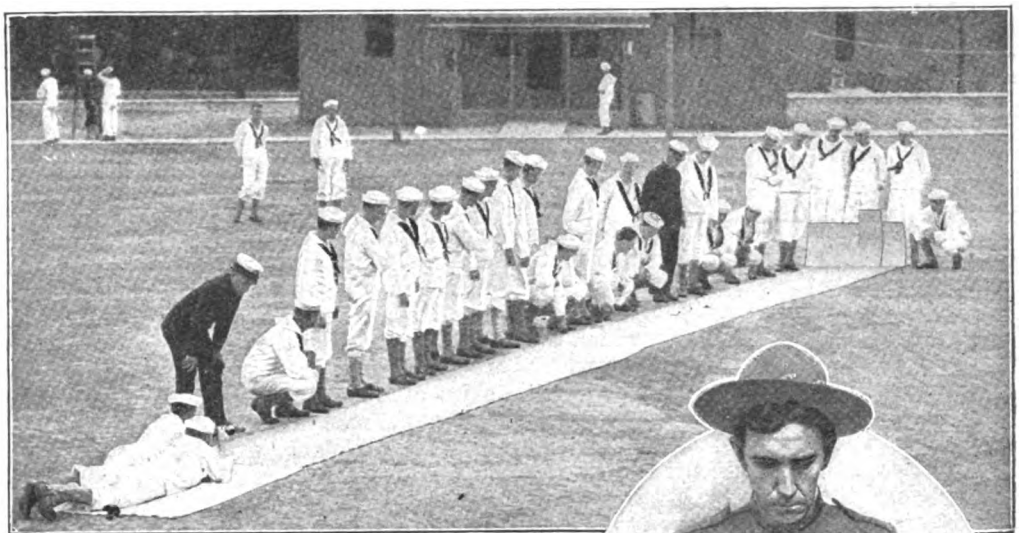

If the man with the glasses is up to his job, the next shot will sink a submarine

Learning on Land How to Pot U-Boats at Sea

MANY things that the fighting sailor must know are being taught on land, in these days of intensive training. You might think that to learn to shoot German submarines you would first have to catch your submarine; but not so. A strip of canvas, a toy submarine, and a few pieces of white paper are all that is needed.

The picture above shows a class of the Naval Auxiliary Reserve, the men who will handle our merchant marine, receiving a lesson at the Pelham Bay Naval Training Station. Look closely and you will see, well down the canvas ocean, a miniature submarine on which the attention of the class is centered. The teacher drops a slip of white paper near the submarine to represent the splash of a shell, and the student with the field-glasses "spots" the splash and calls out a correction to an imaginary gun-pointer. If he has estimated correctly the next "shell" will be a direct hit. If incorrectly, the slip of paper will fall away from the mark.

Everything is made to scale, so that the man with the field-glasses sees a close approximation of what his eyes must measure and his brain judge when he meets a U-boat at sea.

After a day in the trenches. The basin is collapsible and weighs only eight ounces

To Help the Boys in the Trenches to Keep Clean

UNFORTUNATELY, trenches, especially those just dug, are not furnished with bath-tubs and hot and cold water. There may be water—perhaps more than desirable—but no way of collecting it conveniently for washing.

The soldier who carries in his kit one of the collapsible rubber wash basins recently placed on the market is indeed fortunate. The basin is made of rubber-coated canvas and is supported by a lazy-tongs frame made of metal strips and provided with hooks which engage in metal-rimmed holes along the edge of the basin. Basin and frame may be folded to fit into a rubber carrying case.

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Fighting in a Three-Decker Airplane

Fokker produces a fast triplane in which von Richthofen is killed

By Carl Dienstbach

VON RICHTHOFEN, the German flyer who had more victories to his credit than any other living or dead rival, was killed in a triplane. It was a Fokker of a new type, which the German army had rejected, but which von Richthofen thought was well worth trying. The Fokker is not the first triplane. Both Roe in England and Curtiss in America had experimented with the type before the European war. Why did Germany's best flyer select a type that had been discredited?

The two lower surfaces of a triplane do not give as much lift as they would if there were no third plane above them, while their drift—in other words, resistance against propulsion—is the same. Then, why does the triplane idea persist? Because triplanes are stronger than biplanes of the same surface and weight. By sacrificing some of this inherent strength, Fokker made striking improvements possible.

Obviously, triplanes contain a large surface area within a small span of wings. The entire surface closely surrounds the load it has to support. In a fighting plane, above all, the load must be condensed in order to oppose a minimum resistance to the turns and twists that occur in aerial dueling.

Now, what did Fokker do? He turned the framing of the wings, the hollow, box-shaped beams, and the deep-webbed ribs into a truss. Like a bridge, this structure needed no external bracing wires. The framing was tucked away between the smooth upper and under surfaces of the wings. A single light strut, thin and sharp so that its air resistance is negligible, alines rather than braces the triple wings on each side. The absence of bracing struts and cables reduces the machine's head-on resistance so much that the triplane as a whole became as efficient as a biplane.

The commercial flying-machine of the future will probably be a triplane, because we need compact machines in our cities. The military machine of the future may also be a triplane, because its small span permits quick maneuvering.

The greater the span, the greater the difference in speed between the two sides of a quickly turning airplane. As this difference must not exceed a safe limit, the triplane, with its smaller span, is obviously preferable. A small span accelerates turning.

The triplane's ability to maneuver quickly was the reason why it became von Richthofen's tool in a duel in which sudden turns are paramount.

Surface can be piled on surface and certain specifically military advantages obtained. From below and from above, multiplaned machines offer a smaller target. They are safe even after one of the wings has been badly damaged. In a Fokker triplane Captain Boelke would have survived the accident—the tearing away of part of a wing in a collision—that was fatal to him in his Fokker monoplane.

It is a small step from a triplane to a quadriplane or multiplane. The greater the number of planes that are superposed, the less relatively important becomes their reduced efficiency in comparison with their structural advantages.

The Fokker triplane is really a quadriplane. Fokker turned the under frame supporting the landing and starting wheels into a fourth wing. He could give considerable depth and area to this wing, in spite of its necessarily small span. The wheels were disks, forming flanges on each side. This gave to the underframing a certain lifting power, which compensated in a measure for its unavoidable resistance. This fundamental improvement will probably be adopted.

Such a machine has a great speed-range and stupendous climbing power. If it attacks the air at a steep angle it will have great lift at low speed, thus robbing the "airhole" of its terrors and making turning easy while climbing fast.

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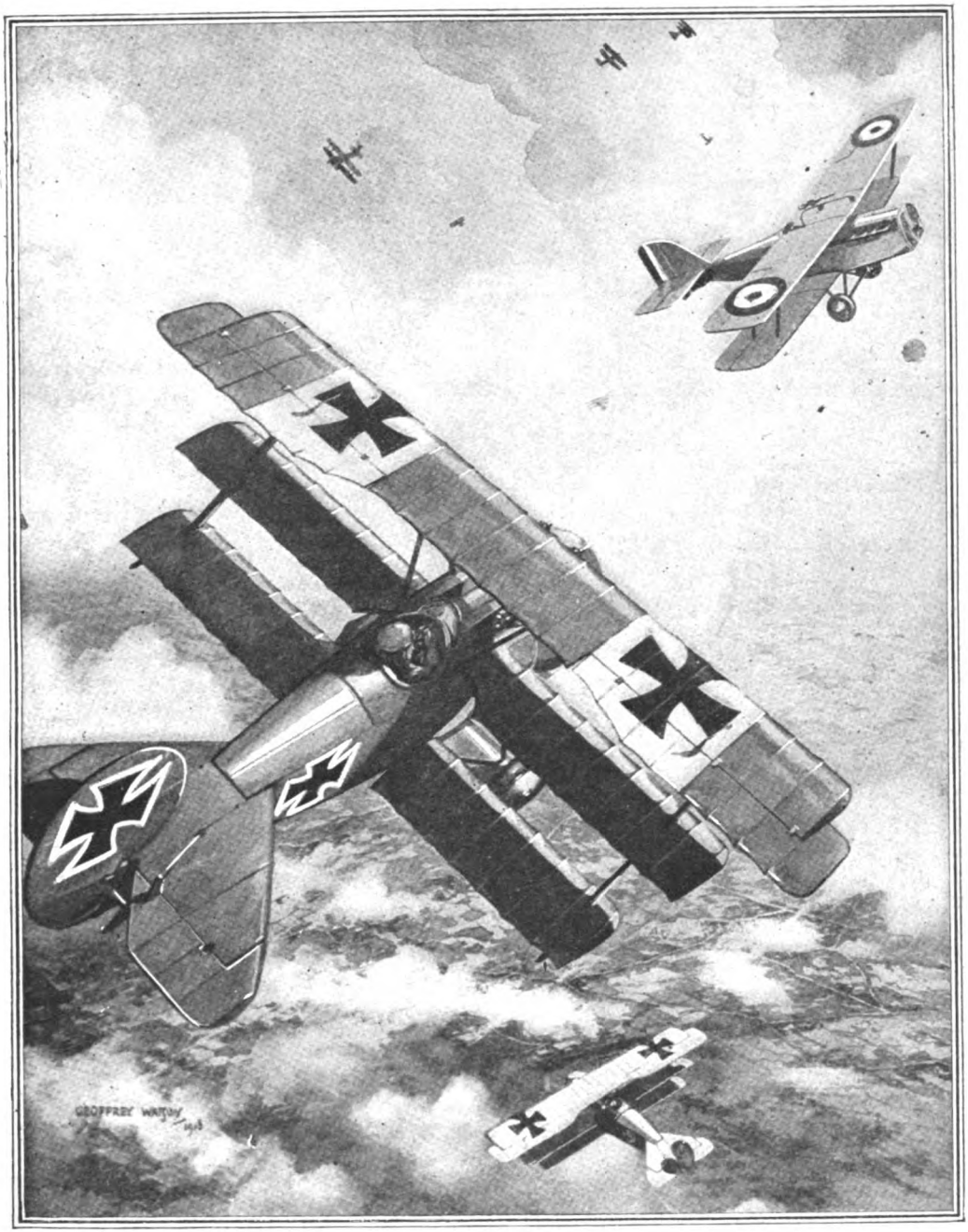
Von Richthofen Flies to His Death



It was in this formidable-looking three-decker Fokker fighting-plane that von Richthofen, the greatest of German airmen, flew to his death. On this Fokker triplane head-on resistance has been cut down by eliminating all wires, and by a new form of landing wheels, mere disks of a stream-line design. Some day an inventor will provide a landing gear that will fold back like a bird's legs. At the moment, the birds are still one hop ahead in this respect

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Honey-Bees that Motor to the Flowers

Being an ingenious method of making the busy bee even busier

Bees ride in this motor-truck limousine to the flowers whose honey they are to drain. By visiting the distant orange-blossom and bean-blossom fields in season, the bees have trebled their output

Introducing L. R. Mercer, chauffeur to several thousand bees. He is standing in the truck that serves as the bees' Pullman

A BEEKEEPER of southern California has found a successful way of offsetting the high cost of living. He takes the bees to the flowers by automobile, thus making the most of the blossoming seasons in different localities. The bee-moving process has long been experimented with by others, but Mr. L. R. Mercer, of Castaic, Cal., has demonstrated that it can be made a success. He claims that his honey crop is now almost three times what it was when the bees were kept in one place the year round.

The theory on which Mr. Mercer works is that ordinarily the bee gathers honey in a radius of two or three miles around the hive. For this reason, they either do a lot of unnecessary work in going over flowers that have already been "drained," or they are practically idle a great deal of the time.

After purchasing a motor-truck chassis, Mr. Mercer designed and constructed a special body, which has screen windows and which is capable of carrying one hundred hives at a time. In the early spring of each year Mr. Mercer conveys his hives by motor-truck from their home ranch in Castaic canyon to the foothills just above Glendora, California, a distance of sixty-four miles, where in the season there are hundreds of acres of orange blossoms. The honey season at Glendora over, the bees are transported to the Ventura district, where they are permitted to remain throughout the summer and tap the bean plants that bloom then.

After the bean-blossom season is closed, Mr. Mercer takes his bees back to the home ranch in Castaic canyon, where they gather honey during the winter from the blossoms of the sage-brush on the mountainsides.

The method of transporting the bees is interesting. After the bees have done their day's work and have retired, the owner carefully closes the entrance to the hives and places them within the truck. All the transporting is done at night. The bees go to bed at Castaic, and wake up the following morning at Glendora, sixty-four miles away. In three night trips the entire apiary is moved.

The body of the truck is equipped with a powerful honey-extractor driven by a gasoline engine. By having the truck equipped in this manner it is not necessary to move the hives heavy with honey; before each moving process the honey is extracted and shipped from the nearest railroad depot.

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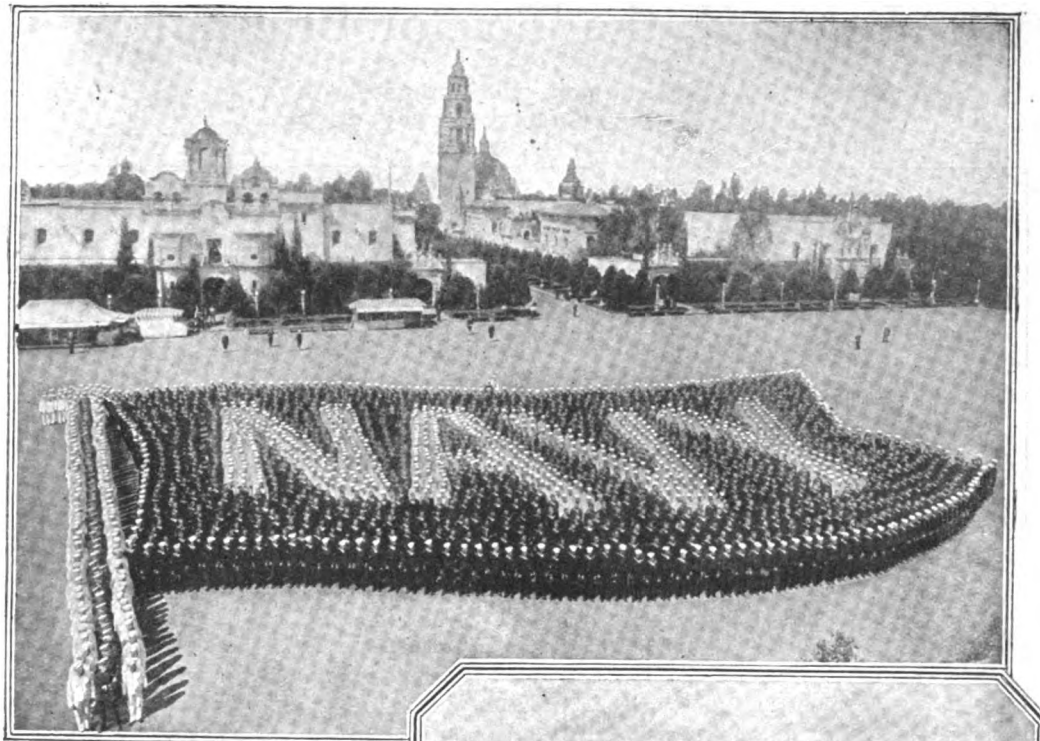
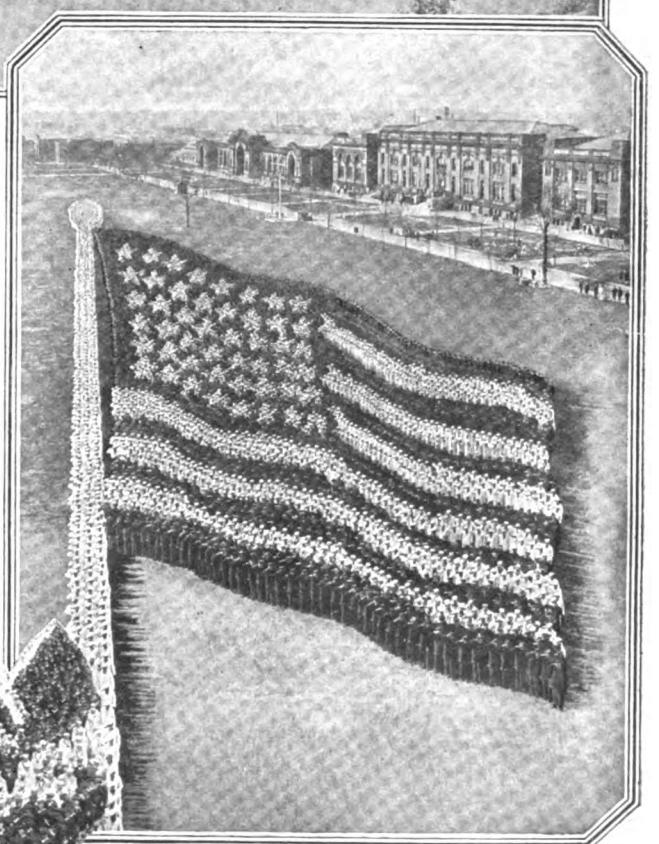
Real Battle Flags of Blood and Brawn

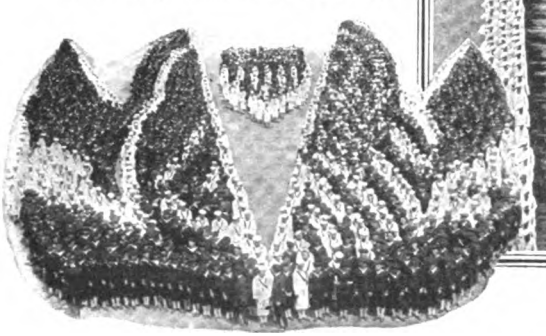


© Western Newspaper Union

Betsy Ross fashioned the first American flag of silk. How her heart would have leaped could she have visioned these giant, living emblems in which the young manhood of the Republic again pledges its allegiance. The one above—a storm warning for German submarines—was displayed at a Pacific coast training station

Expert photographers work out these flags according to the laws of perspective, so that what to the human vision is merely a strangely arranged mass of men becomes to the eye of the camera a living picture—a human flag waving defiance to the foe





© Athletic Association of the Great Lakes

It took ten thousand bluejackets to make this living emblem of union and might

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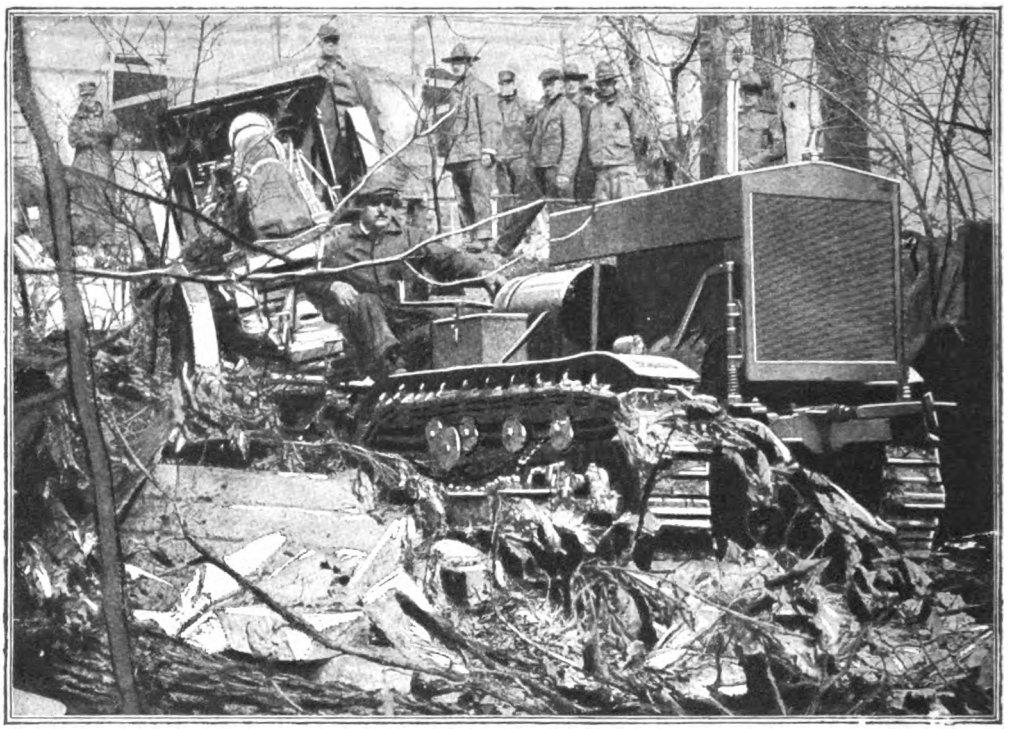
Forward, the Tractor Brigade!

The American guns will keep pace with the advancing infantry in any drive



It takes more than fallen trees, rocks, and piles of brick and masonry to stop the progress of these tractors

FOR days before the big drive the artillery has been firing over the heads of the infantry, which is "dug in" along the edge of No Man's Land, keeping up a terrific bombardment of the enemy lines. The hostile trenches have been destroyed or made uninhabitable; the hostile guns within range have been silenced; and the road is cleared for the drive.

Over the top go the fighters and begin their rapid advance. The wire entanglements have been leveled. The advancing men, supported by their machine-guns, kill or capture such of the enemy as have survived the bombardment.

Hand-grenades and bayonets clean out the trenches and shell-holes, and the forward rush continues until the barrage fire of the enemy's artillery puts a temporary stop to it.

Another zone must be cleared ahead of the zone just occupied. The artillery must keep pace with the advancing infantry to avoid a delay that would enable the enemy to bring up his reserves, place his artillery, and perhaps undertake a counter-attack. But heavy guns and howitzers can not be moved as quickly as infantry over ground cut by trenches, deeply pitted by shell-craters, and obstructed by fallen trees and other debris.

Americans have profited by the lessons of this war. There will be no delay in the forward movement of our artillery when we advance. The Government has planned to equip the army with 40,000 armored military tractors of two and one-half, five, and ten tons capacity, capable of hauling all but the heaviest pieces of field artillery over the roughest ground at a rate of from six to eight miles an hour.

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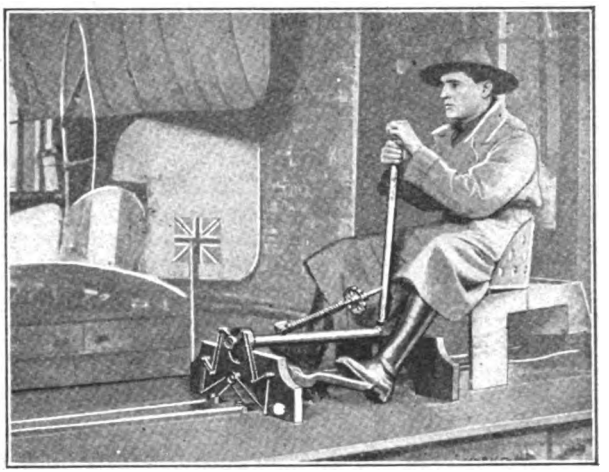
Flying on the Ground with the "Joy-Stick"

TIGHT-ROPE walking requires a well developed sense of balance and a highly responsive action of the muscles. But, in some respects, tight-rope walking is not so hard as maintaining your balance while flying through the air at great speed. An airplane is about as unsteady as a drop of quicksilver on a moving glass plate.

The aviator controls the balance of his machine by means of a lever that has been given the characteristic name of "joy-stick." It controls the ailerons (balancing flaps) on the wings. The joy-stick is a lever normally in a vertical position, and movable in a vertical plane at right angles to the line of flight. It stands in front of the driver's seat, and is controlled with one hand, so that a machine-gun can be fired with the other. To right the machine, the driver pushes the lever toward the side that happens to be too high—a movement that is strictly in accord with instinctive tendency. The rudder, which controls the line of flight, is moved independently by the feet.

The proper handling of the joy-stick requires a well developed sense of balance, and a great deal of practice is required before it becomes mechanical. Aviation students must be perfectly familiar with the working of the joy-stick before they are allowed to fly. Instructors say that students who are impulsive are disqualified from becoming successful flyers. The joy-stick must be handled with great delicacy; a sudden, violent shifting may wreck the machine.

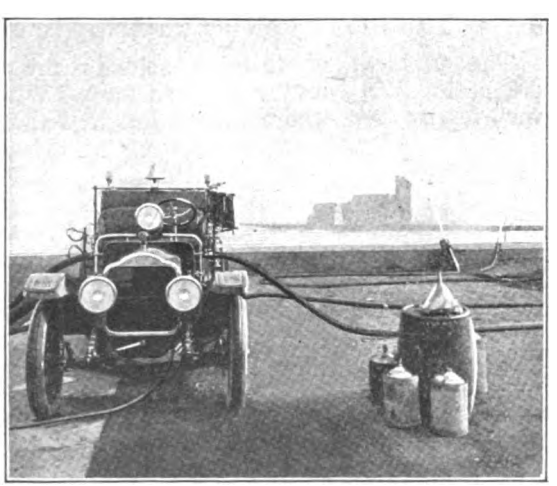


First step in aviation. Oscar is learning how to use the "joy-stick" on the ground

A Champion Flame-Fighter at Work

A FIRE-ENGINE that can stay on the job for two days and a half, throwing 625 gallons of water every minute, and never stopping for an instant, ought to be able to conquer a stubborn blaze. That's the record made recently at Chicago by a new combination automobile fire-engine and truck.

The record beats the best previous one by forty hours. When the machine had been pumping for twenty hours, fire chiefs from all over the country, who were holding a convention in Chicago at the time, went down to the pier on the lake-front to see the wonder at work. They studied it much as a horseman examines a thoroughbred, and found that after sixty hours of continuous work the machine was sound in wind and limb, or, as the experts certified, "the entire motor and pumping equipment was in a very satisfactory condition."



If some burning intellect had set the Chicago River on fire, this pumper would have put it out

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How We Are Making

Motion Pictures Have Been Called Staff in Increasing the Fighting

The information contained in this article and the pictures accompanying it were supplied by the Chief of the Training and Instruction Branch, War Plans Division of the War Department. The article has been submitted to the Department, which has authorized POPULAR SCIENCE MONTHLY *to publish it. The illustrations were made from films actually used in army training.—THE EDITOR.*

WHAT makes a man a champion? Not brute strength alone, not aptitude alone, although strength and aptitude are requisites. If merely brute force and luck were required to drive home a bayonet, a modern army would be nothing more than an armed mob. A champion is distinguished by his motions: he saves energy; he does things in the simplest way.

The main difference between the veteran and the recruit is a difference in motions. This applies not only to the infantryman, but to the artilleryman, the cavalryman—in a word, to every man in every branch of the service. A champion fighter is a man who knows how to move his arms and legs. Hence the foundation of an efficient army is to be found in the science of motions.

The old principle of "any old way, just so long as you deliver the goods," is fast disappearing. The sheer necessity of the present war demands something better. We are meeting an unprincipled, resourceful, cunning, and highly organized enemy. Unskilled men have no place in an organization that fights the German machine. Every unit in the German machine is a champion—a picked man trained by a picked officer. Only by producing an American machine composed of even more highly trained units can we hope to win great victories on the battlefield.

The Job of Raising an Army in a Republic

The problem of training soldiers presents extraordinary difficulties in a country such as ours. When we entered the war, for instance, more than a hundred thousand officers were needed. Lawyers, doctors, business men, citizens from all walks of life, entered the service; and, of all this vast number, only a negligible few had had any previous military training. The War Department was suddenly confronted with the stupendous task of molding not

The gun crews in these pictures are numbered, in order that the recruit may follow easily the movements of any member whose position he is qualifying to fill.

A "close-up" of the gun team in action

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an Army of Champions

to the Colors to Aid the General Efficiency of American Soldiers

only drafted men, but officers, into an efficient standardized fighting machine. The ordinary man can never realize the magnitude of the undertaking.

It is obvious to every reader of the newspapers that time is an all-important element in war, and particularly in this war. To weld our man-power into shape with the least possible loss of time, the General Staff of the Army had always to bear in mind two cardinal principles: first, to avoid a repetition of the mistakes made by our Allies in the early part of the war; second, the attainment of the highest efficiency possible.

The escaping steam would disclose to the enemy the position of this gun. The vapor also interferes with the gunner's view. The Browning machine-gun here shown in operation is water-cooled

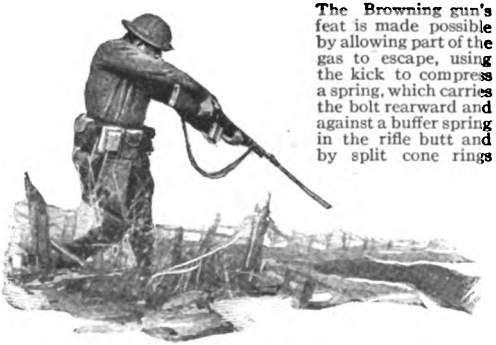
A way had to be discovered of teaching officers and men on a wholesale scale, and yet thoroughly and conscientiously. Teaching from technical text-books alone is too slow. Text-books do not stir the interest, and without interest the process of learning becomes drudgery. Casting about for the most effective way of attaining its purpose, the General Staff decided that the motion picture was an ideal medium.

The Army Makes Use of Our National Pastime

We are a nation of motion-picture theater-goers. Salesmen have found it easy, with motion pictures, to sell agricultural machinery, engines, and complicated mechanism that no prospective customer would ever study from blue-prints or printed descriptions. Technical institutions have been using the motion-picture with telling effect in teaching the principles of shop work. Why not apply the same idea to the training of an army? The General Staff was quick to realize its possibilities, and is to be credited with having for the first time in history converted the film into a living, interesting military text-book.

This condition is effectually eliminated by the adjustment of the steam-condenser here shown. It is easily and quickly attached to the gun-muzzle

It is too early, as yet, to summarize the economies that the motion picture has effected in training men to whom the complicated machinery of warfare was a sealed book; but it is not too early to state that the economies effected can not be overestimated, either in dollars and cents or in time saved. It has proved in every way efficient to obtain efficiency itself by actually showing a man how a thing is to be done on the



The Browning gun's feat is made possible by allowing part of the gas to escape, using the kick to compress a spring, which carries the bolt rearward and against a buffer spring in the rifle butt and by split cone rings

Firing 500 shots a minute into a lake with the Browning to show absence of recoil

The same gun in action with the condenser attached. Nothing there to betray the presence of the gun

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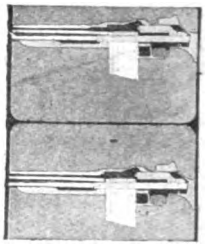
screen, rather than telling him about it by word of mouth or by letting him read it from a book. The rapidity with which the brain grasps information through the eye is fully realized only by the editors of newspapers and by teachers.

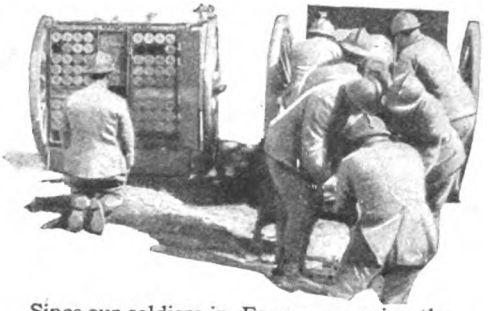


Showing a longitudinal cross-section of the Browning automatic rifle while being fired. The bolt is here in the cocked position

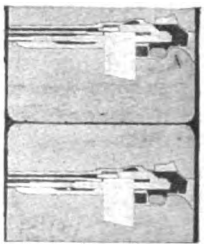
Mr. Browning Tells About His Wonderful Gun

Now, it must not be supposed that the service text-books are thrown into the waste-basket. They are far too valuable for that—indeed, indispensable. The General Staff has organized a motion-picture staff for the purpose of animating the text-book, as it were—to make it alive, to drive home the principles that it elucidates in a concrete, active way.

Hence the most competent and experienced instructors have been enlisted to appear before the camera, and by their photographic example to demonstrate how the essential drills are to be executed.

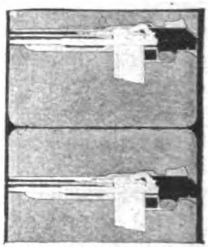


Since our soldiers in France are using the French 3-inch gun, it is necessary to instruct our men in this country in its use



Continuing, the bolt is shown pushing the cartridge from the magazine into the bore

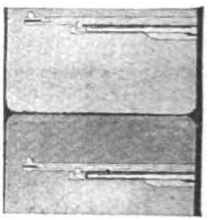
Imagine yourself in a dark room. The silence is broken only by the whirring of the projecting machine's motor and the passing of the film before the lens. On the screen you see what? John M. Browning, inventor of the Browning machine-gun. You meet the man himself—his disembodied photographic personality.



The bullet leaving the sheet under pressure of the expanding gas. The action is retarded so that one may see exactly what takes place.

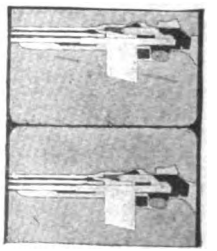
Would you not rather learn the mechanism of that remarkable gun from the inventor himself than from anyone else? Of course you would. And so Mr. Browning points out the different parts of his wonderful gun, and names them. He shows you how the gun is taken apart; how it is cleaned; how it is put together again; how it works. Even the mistakes that are likely to be made by an uninstructed man are called to your attention by Mr. Browning on the screen.

No text-book could so rivet your attention; no blue-print could fascinate you as does this picture on the screen. You can't help but learn, for the demonstration is a little drama in technology.



At this point the gas has passed through the port under the barrel and is seen forcing the piston rearward. As the piston moves rearward it compresses a spring

The champion does things in the best way, whether he be a champion tennis-player, or a champion bricklayer. There is just one best way to curry a horse, to aim a gun, or to drive a bayonet into a human body, and that way is the champion's. Every one wants to be instructed by a champion. Since there are not enough champions to instruct an army that numbers its officers and men by millions, motion pictures serve the purpose of multiplying a single champion hundreds, even thousands of times. A single man, an expert in his chosen field, can be photographed once and for



The spring now comes to view. When it is released this pent-up force carries the bolt forward again. The two forces just described constitute the principle of automatic gas-operated rifles

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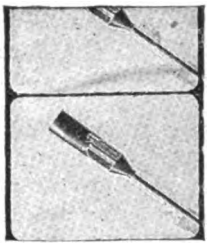
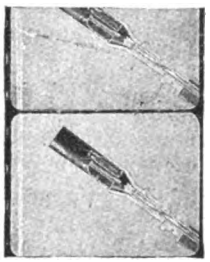


The discharger with grenade inserted and photographed so that you may study its mechanism

all, and the film used to teach a whole army. This method of teaching, moreover, leads to uniformity of result. It is better to teach all men to follow the example of a single champion than to use a hundred champions. Clearly, no hundred champions will ever be equally efficient. But the motion-picture champion—the one man who embodies in himself all that the army wants to impart—can magically transport himself from New York to San Francisco and exhibit himself in a hundred places at once for the instruction of recruits.

Three different kinds of motion pictures have been developed, and by means of these three different types of pictures the screen is made to reveal events and actions that are never seen in real life.

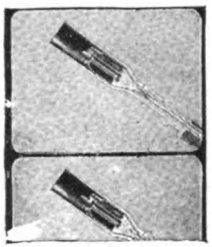


The bullet is here seen about to enter the tube of the grenade. The smallest detail is made plain for the students

The Three Types Used in the Army

The first type of picture is not essentially different from that which is exhibited in every motion-picture theater. Photographs are made of men drilling; of artillery in action; of cavalrymen; of the many different phases of army activities.

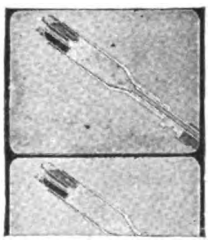
The second type of film is not generally known to the public. It is made with the assistance of a speed camera. To explain what that is, let it be said that the ordinary motion-picture camera makes exposures at the rate of sixteen per second. The speed camera, however, makes ninety-six per second. The pictures are projected on the screen, not at the rate at which they were taken, but at the standard rate of sixteen. Hence motions executed with the utmost rapidity appear to be of snail-like slowness. And, because they are slow, they can be studied.



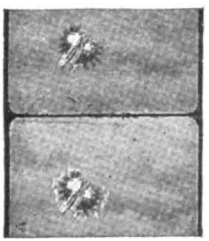
The grenade fuse is set off by the bullet. While the fire burns toward the detonator, gases accumulating behind the grenade force it out, as shown in the next picture

Suppose it is desired to know what a horse does when he changes his gait, and where the center of gravity of a rider should be. The army uses hundreds and thousands of horses. If it could teach men quickly how to ride, it would save many a horse from acquiring a sore back while imparting worth-while knowledge to cavalrymen.

The ordinary motion-picture camera will not catch the motions of the horse and rider so that they can be projected for convenient study. But use the speed camera, and the animal moves at one-sixth of its actual speed. Hence every phase of its action can be studied.



The explosion of the grenade is also retarded so that you may observe how it shatters itself into 50 or 60 death-dealing fragments (see below)



How does a grenade discharger work? All you have to do to find out is—look. On the screen everything is made plain

The third type of picture, the animated cartoon or drawing, has become familiar to the public through the work of well-known newspaper artists. Nearly all of these films are burlesque or highly

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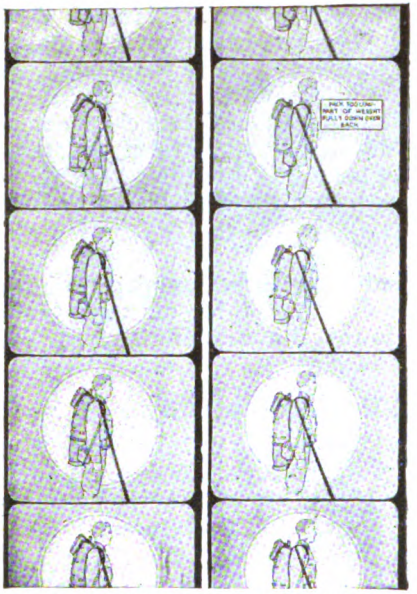
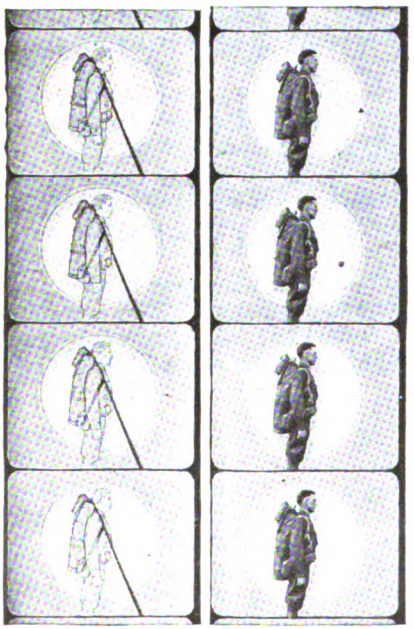


At the left: A diagrammatical drawing in motion to illustrate the proper method for carrying the pack, and the scientific principle upon which the theory is based. Properly adjusted, the shoulder-straps will be horizontal. At the right: The pack as here seen is carried too low, exerting undue downward pull upon the shoulders. This is extremely fatiguing

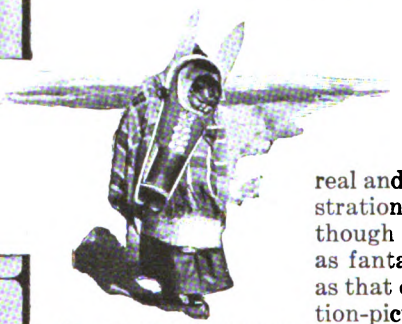


At the left: As the motion picture progresses the pack is seen to rise, illustrating the error of carrying it too high. In this position the pressure of the straps is very uncomfortable. At the right: Having served its purpose, the diagram dissolves to the actual photograph of a soldier properly carrying the pack

comic in character. Only a few have been made for purely educational purposes. It takes time and patience to make an animated drawing.

A motion picture of any kind, be it remembered, is composed of hundreds of pictures following each other in natural sequence so as to show the beginning and end of progressive movement. That these hundreds of pictures seem to be continuous is due to a phenomenon known as "retinal persistence." By that we mean the inability of the eye to see each picture separately as it flashes by. It is because the eye is slow that motion pictures are possible.

To make an ordinary drawing, hundreds, even thousands of separate pictures must be drawn by an artist. Each picture shows a moving part in a position slightly in advance of that shown by its predecessor on the screen. When these drawings are projected at the rate of sixteen a second on the screen, the result is a real and convincing demonstration of motion, even though the subject may be as fantastic and as absurd as that of the ordinary motion-picture cartoon.



The U. S. infantryman carries his pack after the fashion of the Indian squaw with her papoose

In army work the animated drawings have been applied to show how the entire mechanism of an automatic rifle works—something that can not be revealed so realistically even with the aid of the rifle itself. Moreover, the movements of the various parts can be so timed that the course of the bullets and of the gases can be readily followed. In this field alone army use of the motion picture has justified itself.

Whole Process Simplified by Moving Pictures

Can you tell a man, from the mere aspect of an automatic pistol, how it works? Would it not be laborious even with the aid of a drawing? On the motion-picture screen the whole process is reduced to something like axiomatic simplicity. The trigger is pulled; you see it. The striker hits the primer; again you see it. The powder gases explode; you see them expand. A piston is pushed by the gases to operate other mechanisms. Nothing is left to the imagination. Everything is revealed to you.

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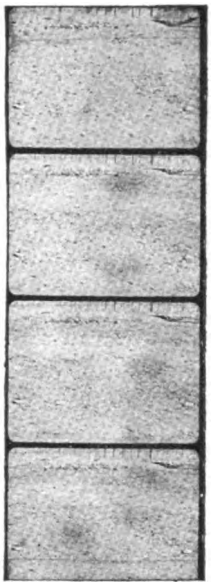


A perfect example of camouflage. Here, right in your path, is a deadly machine-gun that is ready for instant business. Can you locate it?

The method has infinite possibilities. There is hardly a subject that can not be elucidated by means of the animated drawing. How the cylinders of the large guns recoil, how bullets fly through the air to their mark, laws in mechanics that are dry and meaningless to those who have not been schooled in mechanics — all become dramatically interesting, all assume a new meaning and dignity.

How Our Army Was Speeded Up

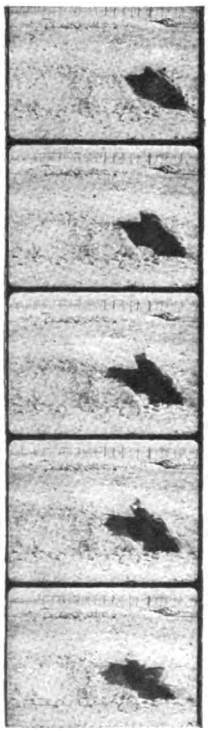
At the request of the United States Government, hundreds of experienced officers have been sent to these shores by our French and British Allies in order to help us train our armies.

Six seconds have elapsed from the time the view of the flat ground was taken. The gun is already in action

Because we have many kinds of instructors, there is a very obvious need of standardization. The recruits from California and the recruits from Virginia and Texas must receive the same training, if we are to avoid friction and confusion in our war machine. The motion picture has reduced the possibility of that friction and confusion to a negligible minimum.

Up to the present time, twenty-two subjects have been completed. They will serve to instruct the men in all branches of the service, and they will be used to train troops numbering at present nearly two million men.

The first step in preparing a reel is the writing of a scenario, in which everything to be shown is tabulated in detail. The next step is the coaching of the champion or super-expert in the presentation of the subject chosen.



Here the moving-picture camera has caught the gun just ready to spout

This super-expert rehearses his part far more thoroughly than is demanded of an ordinary motion-picture actor. Human lives depend upon his intelligence. Defeat or victory, too, rests to a certain extent with him. It must not be forgotten that all champions are not necessarily first-class teachers.

The next step is the taking and developing of the pictures. After that they are shown to large gatherings of critical technical experts. Then they are re-edited, submitted to the General Staff for final approval, and distributed throughout the service.

So successful has been the motion-picture method of instruction that the demand for more and more reels, and for education in more and more advanced work by means of the film, is increasingly insistent.

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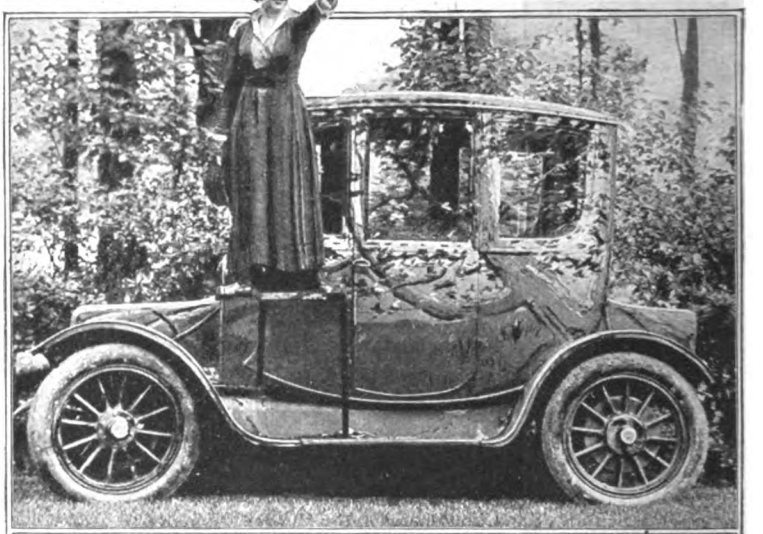
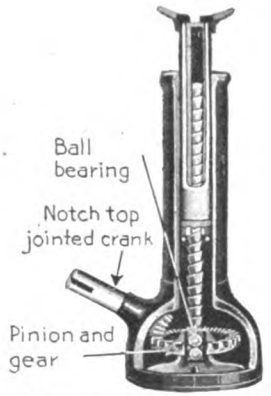
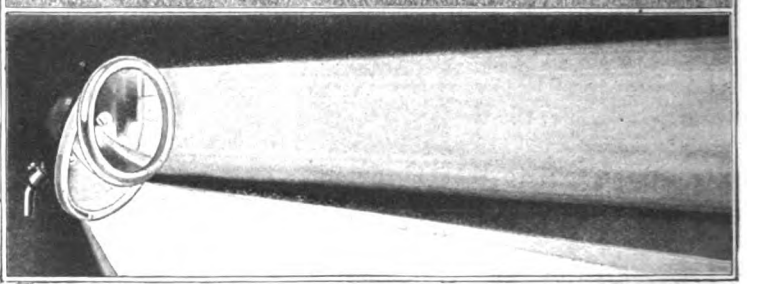
Giving Mechanical Aid and Comfort to

An automobile disguised to attract attention in a recent thrift stamp campaign

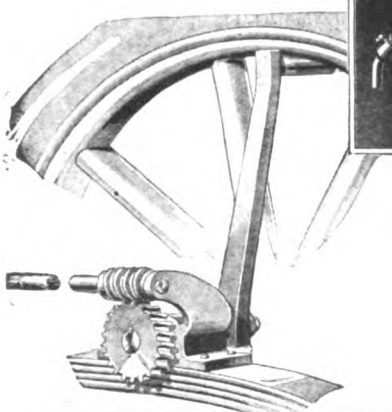




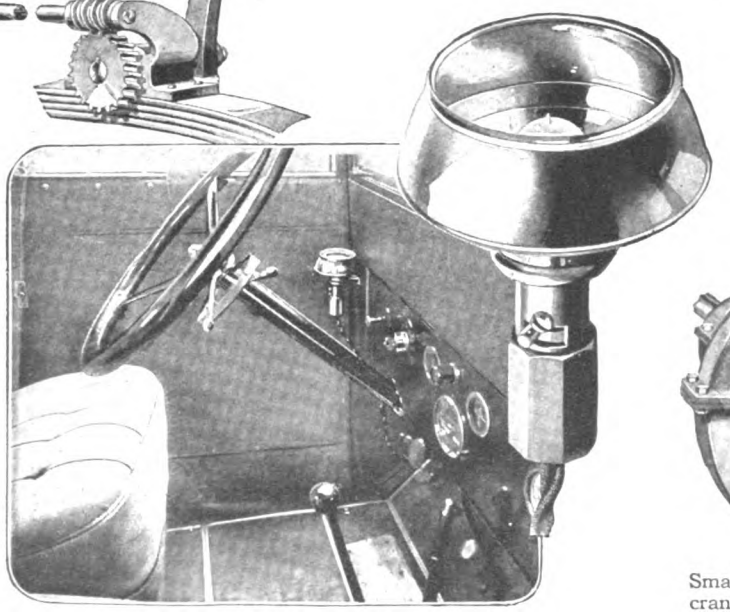
A split used in an auto-jack to permit the plunger to drop when axle is to be lowered



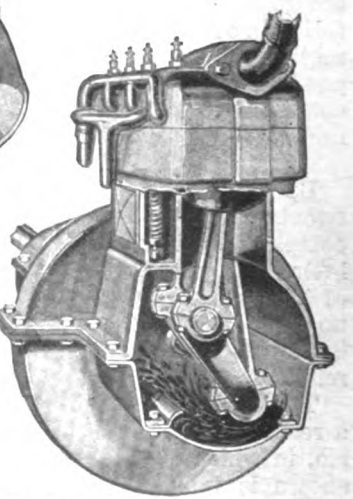
An auxiliary automobile headlight which throws the light down when driving through city streets



At the left is shown a lowering device for the spare wheel, which is attached to the rear spring



Small spot-light for ready attachment to the storage cells of an automobile for emergency use



Small baffle plate attached in crank-case for the purpose of keeping oil in pan when the engine is running at high speed

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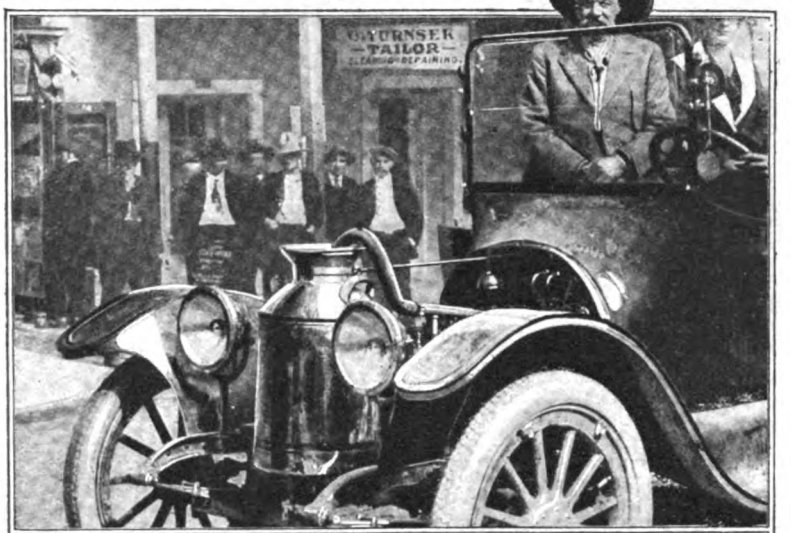
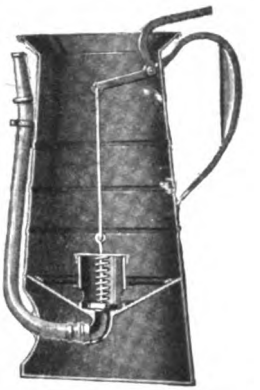
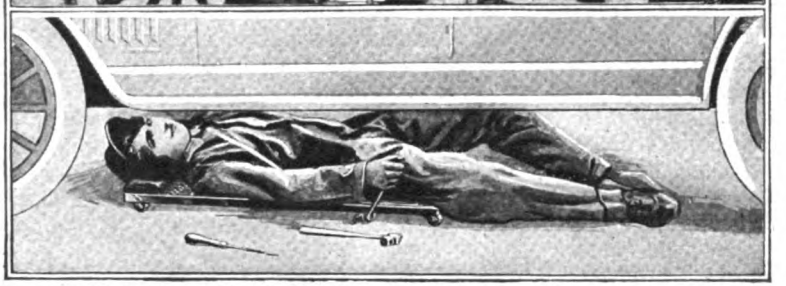


This ranger in the picture at the left, having accidentally smashed his radiator in the desert, replaced it with a milk can



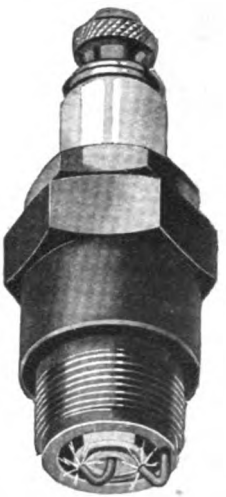
Measuring can with strainer at bottom and discharge outlet through nozzle



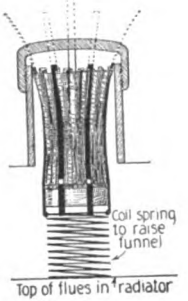
A creeper spring bed with rollers attached enables the repairman to work at ease

The wedge is pushed in between the leaves of the spring, and the groove in its surface carries the oil in

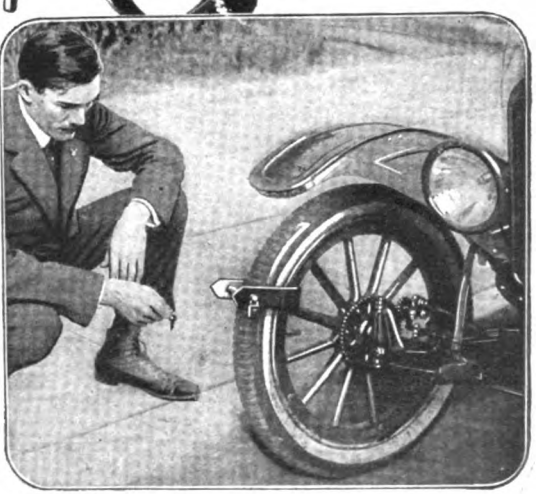
At the right, a lock attached to the steering wheel prevents its turning



A twin spark plug in which two sparks fire independently



This filler cap strainer spreads in funnel shape when pushed out as the cap is removed



An auto-theft signal on front wheel becomes a mud-hook when fastened to rear wheel

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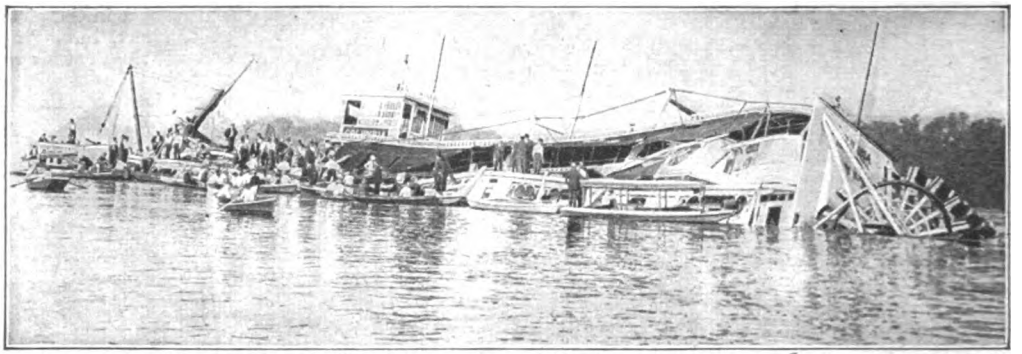

About a hundred men, women, and children were overtaken by death when the excursion steamer "Columbia" sank in the Illinois River

Not a U-Boat—Just a Snag in the River

THE sinking of the excursion steamer *Columbia* in the Illinois River recently is another illustration of the fact that, even in this day, man is not yet completely master of the elements. Compared to an ocean voyage, with its perils from submarine and storm, a trip on the Illinois River seems safety itself; and certainly there was no thought of peril in the minds of the five hundred men, women, and children who had enjoyed a perfect summer day on the water and were returning home.

The big stern-wheel steamer ploughed her way along steadily, the excursionists dancing, singing, and feasting with as much security as though in a hotel on shore. Then came the crash of rending wood and iron. The boat stopped short, swung about, and began to back slowly. The moment of panic was followed by one of reassurance, and then came frantic terror and indescribable confusion as the *Columbia* keeled over and began to sink. She had run upon a sand-bar or a snag, which had broken her backbone.

River steamers of this type are not fitted with water-tight compartments, and such bulkheads as there are have little or no resisting power; so when the *Columbia* broke in two she sank to the river-bed almost at once.

Nearly a hundred of the merry-makers were drowned, in spite of the boats that swarmed about the sinking steamer. An investigation of the accident was ordered, and an effort will be made to raise the partly submerged boat.

No Wonder This Bull Put Up at the Best Hotel

DURING the shorthorn cattle sale at Ashville last May, Mr. Roan Prince and Mrs. White Rose were guests at the Hotel Langren, and we are privileged to present their pictures, posed in the special suite prepared for them. The bull and his lady were entertained by the Red Cross. That was very nice of the Red Cross, and also very nice for it, since Roan Prince was given to the organization by I. F. Derby, of Athens, Alabama, and the Athens chapter was richer by $12,600 when Dr. I. V. Legg bought the celebrated shorthorn at auction.

Unusual hotel guests? Yes; but the gentleman on the right is worth $12,600

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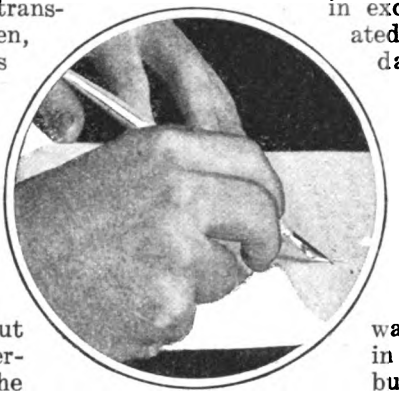
Promoting an Ordinary Steel Pen into a Fountain Pen

BY means of an ink-feeding attachment that can readily be affixed, an ordinary steel pen can be transformed into a fountain pen, which writes as many as five hundred words without refilling. As shown in the photograph, the ink-spoon serves as a reservoir for the ink, which runs down the slit in the nib as needed. The ink remaining when the pen is no longer required can be drained out by placing the pen in a vertical position against the inkwell and pressing slightly. The ink-spoon is cheap, as compared with the fountain pen, and enables the user to select the particular kind of steel pen which he prefers for his own work.

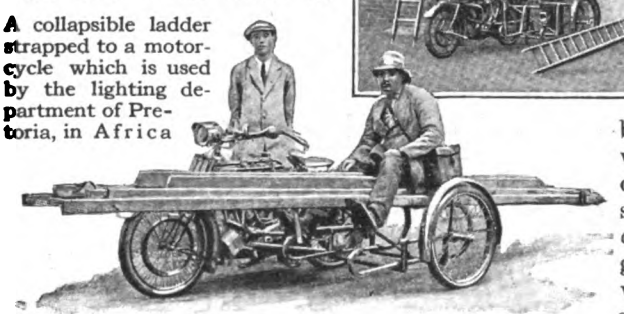


It's an ordinary steel pen, just as you supposed, but it's been changed to a fountain pen

Five cents will buy one of these ink-spoons. If it is warranted not to clog, it ought to work as well as a fountain pen.

A Motor-Cycle Ladder in Electric Light Work

A COLLAPSIBLE ladder strapped to a motor-cycle, as shown in the illustration on the right, is employed by the electric department of Pretoria, South Africa, for installation, repair work, disconnecting and connecting. Pretoria, which is one mile wide and seven miles in length, has 4,600 electric light consumers who are supplied by wires supported by poles thirty-six feet in height. The ladder motor-cycle has demonstrated its worth by reaching points in the lighting system in excellent time. It is operated about fourteen hours daily, averaging more than forty miles. It weighs about 260 pounds and is put up in sections.



A collapsible ladder strapped to a motor-cycle which is used by the lighting department of Pretoria, in Africa

Mines and Mining at the Battle-Front

ASIDE from fighting and keeping a close watch on the enemy, soldiers in the front line trenches are busy digging more trenches or improving their dugouts when on duty. Occasionally some are detailed to dig tunnels and lay mines. These mining operations are carried on under the direction of army engineers. The construction consists not only of offensive mines attacking enemy strong points, but systems of countermines with the object of detecting and repelling enemy operations.

Tunnels are dug underground leading to points beneath strongholds of the enemy, at which explosives are deposited and set off by time fuse. The blowing up of Messines Ridge by the British in their drive in 1917 is a conspicuous example of such mining operations.

A campaign is constantly going on underground with the aid of microphones and other listening devices. When an enemy tunnel is discovered, it is blown-in by running a boring close to its wall and exploding a quantity of explosive sufficient to destroy the tunnel, but not to disturb the upper surface of the ground. The name camouflet, a word of French origin, has been given to such a mine.

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Shooting Birds from Airplanes—A New Sport

NO sport is so ancient and captivating as hunting. It was not always sport. In the early days of the human race hunting was a necessity, almost the only means of subsistence. Later it became the favorite pastime of a constantly narrowing circle of devotees. In feudal times it was the exclusive privilege of kings and noblemen.

There is an old saying: If the cat had wings it would go ill with the sparrows. Winged man can be even more destructive

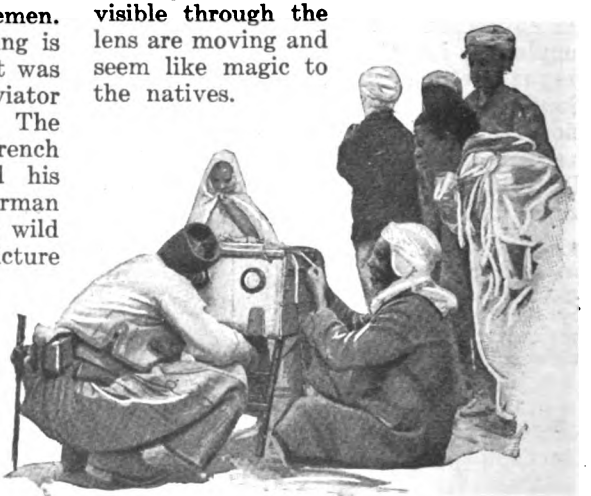
The latest development in hunting is duck-shooting from an airplane. It was first tried with success by the aviator Hubert Latham, a few years ago. The accompanying picture shows a French aviator in Servia who employed his leisure time, when not chasing German or Austrian airplanes, by shooting wild ducks from his airplane. The picture shows him with the double-barreled shotgun he used to kill the ducks which hang like a festoon on the outside of his fuselage. The modern Nimrod evidently had a successful day, judging from his fine "bag."

The aerial hunter is by no means restricted to flying game. With a driver to steer the machine, the hunter can devote himself exclusively to the pleasure of the chase while going through the air at eighty miles an hour. It is not likely, however, that hunting in airplanes will ever become a popular pastime. Airplaning as a pleasure is a trifle too expensive and risky and becomes even more so when combined with hunting. In addition there is the drawback of gathering in the game after it has been shot. Nevertheless, laws prohibiting hunting in airplanes have been enacted in several states. It was feared that hunting in airplanes, being so much easier than other methods of hunting, would soon cause the complete extermination of every kind of game.

Even Far-Off Fez Succumbs to the Fascination of Moving Pictures

EVEN the dark-skinned natives of picturesque Fez are not able to resist the fascination of moving pictures. The interesting and thoroughly characteristic street scene in Fez, shown in the accompanying picture, bears witness to that fascination.

Heaven only knows where the shrewd old Arab in the foreground learned of moving pictures and their mechanics and where he picked up the outfit with which he is earning a living at the rate of two centimes a peep. The machine which the old Arab uses is probably of a most primitive kind, but the pictures visible through the lens are moving and seem like magic to the natives.



"Gather around, ye faithful, and see the white magic of the moving pictures! Only two coppers a peep!"

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Driving Them Nine a Minute

Unearthly din in our shipyards foretells trouble for the Kaiser

By Frank Parker Stockbridge

The broad grins mean that "the gang" has just hung up a record at the Northwest Steel Company's plant by driving 4,091 rivets in nine hours, and besides, they had two bad ones to cut out and lost fifteen minutes on slight repairs to the machine

THE contest for the title of "World's Champion Riveter" is in full swing. Records are being broken almost weekly. The competition began in March of this year and the title has passed since then twice across the ocean; from the Atlantic Coast to the Great Lakes, and for a few minutes to the Pacific, with the Gulf ports as strong contenders. Just as this is written it seems to have been captured in Ireland by the incredible performance of John Moir of Belfast. According to cable dispatches, he drove 12,209 rivets in nine hours in a standard ship. This far exceeds the best previous record, made by Charles Knight, an American negro riveter at the Sparrow's Point Bethlehem yards, near Baltimore. Knight drove 4,875 three-quarter-inch rivets in nine hours. For this feat he was awarded the prize of $125 offered by Donald McLeod, a British shipbuilder. It was a profitable day's work for Knight and his helpers.

From the early days of March, when construction work under the U. S. Shipping Board's huge program began to get well under way new high records for rivet-setting were, for a time, of almost daily occurrence. Seven hundred rivets in a nine-hour day had been regarded as a remarkably good performance for the standard "gang" of riveters, "holders-on," "passers-up" and "heater-boy," even with the best of modern high-speed pneumatic riveting hammers. Under the spur of high wages and the patriotic urge to speed up shipbuilding, gang after gang began to double and even treble these figures. The game began at the Submarine Boat Company's yard at Port Newark, N. J. John Frederickson started it when he drove 836 seven-eight-inch rivets for a day's work. The word spread to other shipyards and C. McBride, at the Pusey and Jones shipyard, Wilmington, Del., topped it with 1,016 rivets of the same size, an average of 113 rivets an hour. McBride beat his own record a little later with 1,031 rivets. Then Henry Beckels, at the Downey yards on Staten Island, startled us with 1,089 rivets. Baltimore took the lead next, Charles Golderick and Louis Rehak of the Baltimore Drydock and Shipbuilding Company driving

We are sorry that the gentleman on the left isn't attending more strictly to business. He is running a pneumatic caulker and, as it is important to have deck plates water-tight as well as strong, he ought not to be so interested in the other fellow who is driving rivets

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respectively 1,202 and 1,414 rivets, working only eight hours. But while their mates were still cheering them word came from Buffalo that John Fraser of the American Shipbuilding Company had driven 1,624 rivets in 8 hours and 43 minutes.

John Stark started out in the Buffalo yards to take Fraser's figures down. He succeeded, setting 2,089 rivets in 8½ hours. While he was doing it Charles Schock, at the Baltimore yards, drove 2,720 rivets in nine hours. This unparalleled feat by Schock attracted attention in every shipyard in the civilized world. Lord Northcliffe published the figures in his London papers and on April 20th Robert Farrant, in the Fraser and Fraser yards at London, proved that the English were not so slow by driving 4,267 rivets in nine hours. Even a new American record of 2,919 rivets in eight hours made by Edward Gibson at the Federal yards at Kearney, N. J., did not compare with this.

But Gibson's figures did not stand very long as the American record. John Corrigan beat them at Chicago with 3,415 rivets in nine hours, an average of 379 an hour against Gibson's 365. That stood as the highest American record until Knight's prize-winning performance.

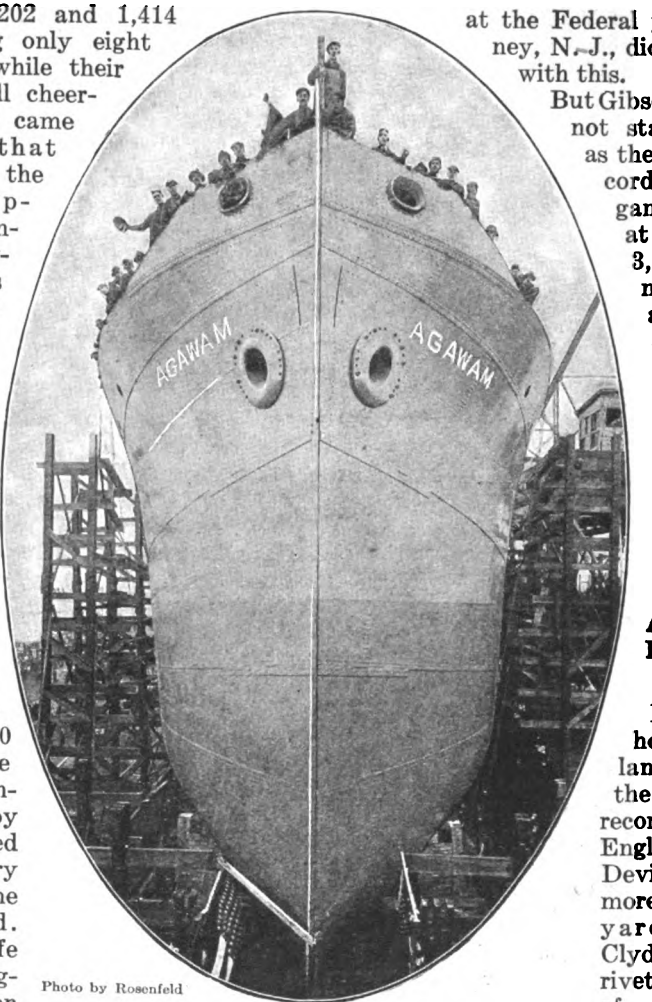


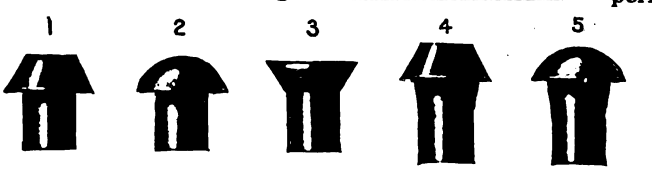
Photo by Rosenfeld

Look at her—studded with rivets, half a million of them for every similar standardized ship of 5,500 tons. If she were 8,000 tons, they would number nearly a million. Every one of them was driven home as if the riveter were working on the Kaiser's devoted head

A Rivet Every 6⅔ Seconds

Meantime, however, Scotland had taken the international record away from England. Thomas Devine, at Reardmore's Dalmuir yards, on the Clyde, drove 4,422 rivets in the side of a ship in nine hours. This was the record beaten by Knight, whose performance still stands as the officially-certified high record, the Belfast figures of 12,209 rivets being regarded with much skepticism on this side of the water.

Knight's performance meant that



Rivets Used in Ship Work

The three standard types of rivets used in ship work are the cone-head or pan-head rivet, the button - head, usually called "snap" rivet, and the countersunk rivet (Figs. 1-2-3). Figs. 4 and 5 show pan-head and snap rivets of the "swell-neck" type, used where the holes in the plates have been punched instead of drilled. Rivets are drop-forged from steel bars by automatic machines. The diameters of rivets most commonly used in ship work are ¾ in. and ⅞ in. The rivet hole is usually a quarter inch larger in diameter than the thickness of the plate

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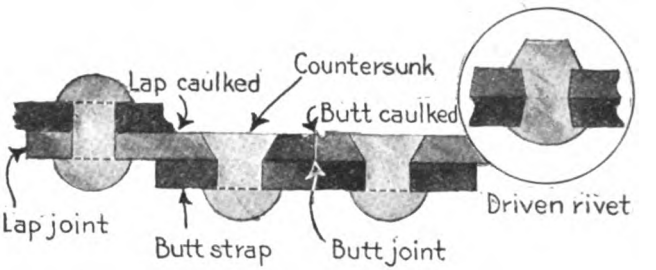
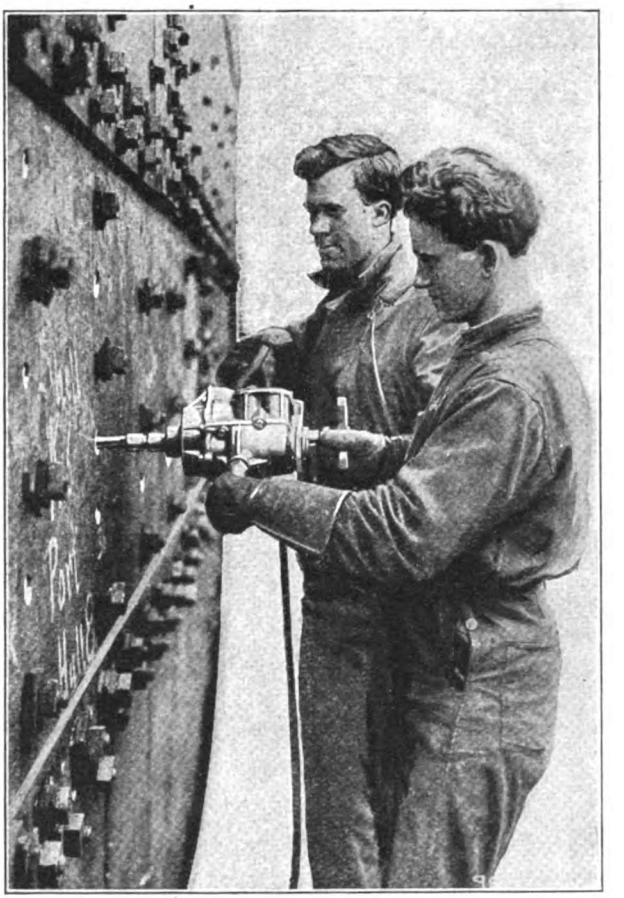
he drove 541 rivets an hour, or a trifle more than nine a minute, an average time of 6⅔ seconds to a rivet. Even at this high speed, allowing one-third of the time for shifting from one rivet to the next, the pneumatic hammer made it easily possible for him to strike sixty-five blows on each rivet-head, amply sufficient to set each rivet properly where water-tight joints were not required. It should be remembered that none of the remarkable records cited was made on water-tight work. Knight was working entirely on hatch strong backs, the built-up reinforcement around the hatch openings in a steamer's deck, where strength and rigidity are the essential requirements. On the parts of a ship that must be water-tight, such as the shell plating below the water-line, bulkheads separating water-tight compartments, etc., an average speed of 500 rivets a day is very good work. Ship plates are seldom planed, especially where speed of construction is necessary, and the riveter's skill is depended on to pull the lapped surfaces together, straightening out not only any warped places but taking care also of any buckling caused by the operation of riveting. This condition makes water-tight riveting necessarily much slower than work on other parts of the ship. In the United States Navy yards only hand riveting is permitted on this class of work. In rapid merchant-ship construction such as is now going on, seams are sufficiently caulked by means of the pneumatic caulking chisel, which "upsets" the edge of the overlapping plate and red lead and paint do the rest. In most cases this method of water-tightening is sufficient.



How Riveted Hulls Are Made Water-Tight

Cross-section showing how the two styles of plate-joints are caulked to make them water-tight. On lapped joints, which is the usual method of construction, the edge of the plate is "upset" as shown, by means of a caulking chisel, which is simply a cold-chisel inserted in place of the hammer head in a pneumatic hammer-tool. This is run along the edge of the plate, striking a thousand or more blows a minute, and expands the metal so that the joint is perfectly tight. Where two plates are abutted and riveted to a strap, the joint is caulked by running the caulking chisel along the adjoining edges of both plates.

In insert: Cross-section showing a pan-head, swell-neck rivet in place. The tapering hole is formed by the punching machine.



Halted a moment to have their picture taken, these drillers will soon have the little reaming engine going again

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How a Championship Riveting Team Is Made Up

The riveting gang consists of the riveter, who handles the pneumatic hammer, the holder-on, or bucker-up, as he is sometimes called, who holds the head of the rivet while the riveter, on the other side of the plate, converts the point into a head, the passer-up, and the heater-boy. In the record-breaking teams the heater-boy is not a boy at all, but a full-grown and very expert man, who can keep a dozen rivets at a time heating in his little portable forge without letting any of them become too hot, and who tosses them with unerring accuracy to the passer-up at clock-like intervals.

No better way of heating rivets than the coke- or oil-burning forge has yet been found for ship work. For shop work electric forges have sometimes been found satisfactory, but the cost of running them is greater than that of running coke or oil forges.

The passer-up has to be a skilful catcher of red-hot rivets (the proper temperature is just below white heat), and he must be apt and quick in inserting them in the holes. When it is difficult to have the furnace near the place where the riveting is done, the rivets have to be thrown sometimes a considerable distance. In such cases the passer catches the rivets in a keg or bucket. Seizing the rivet with his tongs, he inserts the red-hot rivet in the hole, and then prepares to receive the next rivet from the heater-boy.

The holder-on uses an implement called a dolly-bar to hold the rivet in place while it is being hammered. This tool varies according to the fancy of the holder-on and the space he has to work in. On water-tight work, where he has something to brace the tool, he may use a pneumatic dolly-bar similar in principle to the pneumatic hammer. More often, however, he uses either a sledge-hammer or a stout steel bar with a recess at the end to engage the head of the rivet.

After the riveter and his gang have completed their work, it is tested to make sure that all the rivets are tight and sound. The closeness of the joint is tested by

Team work—that's the answer to the "why" of riveting records. The "heater-boy," armed with the tongs on the left; the "passer-up," just placing a red-hot rivet in place, and the "holder-on" who is bucking the force of the driving pneumatic hammer, are as important in their way as the man on the business end of the hammer—but he gets the glory

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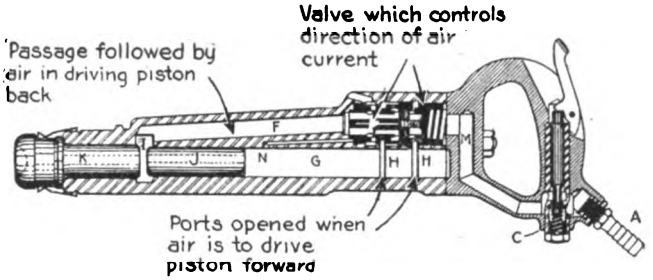

In use the hammer (*K*) is held firmly against the point of the rivet. The hammer effect is obtained by repeated blows of the piston *J*, which is driven back and forth in the cylinder *G*, by compressed air at a pressure of from 80 to 100 lbs. The standard piston has a stroke of about 8 inches, in the size of hammer usually used in ship work, and strikes about 750 blows per minute. On some classes of work expert riveters use pistons as short as 1½ inches, and most of the high speed records have been made with shortened pistons, striking as many as 1,400 blows per minute.

Air from the compressor is led through a flexible hose to the hammer, at *A*. The trigger under the riveter's thumb operates the cut-off valve *C*. When air is admitted it passes through the channel *M* to the operating valve. With the piston in the position shown in the cross section, the air would travel through the channel *F* and enter the cylinder by the port *I*, forcing the piston back toward the handle end. As the piston passes the port *N* the ports *H H* are opened and the air is cut off from *F*. This drives the piston down on the hammer or rivet-set, the momentum being sufficient to carry it the full length of the stroke before the uncovering of *N* again reverses the direction of the air and sends it through *F* and *I* to drive the piston back again. The whole apparatus weighs about 25 pounds and is about 20 inches long

means of a thin-bladed knife, the insertion of which between the surfaces should not be possible. The rivets are also tested by the tapper, who strikes the head of each rivet lightly with a hammer. The tapper is so expert that he can tell by the sound whether there is any play between rivet and plate or not. Faulty rivets are cut out and new ones are put in their place. The rivets thus removed are carefully collected, and most of them are cut down to a smaller size, to be used on another job.

What Five Extra Rivets per Gang in an Hour Means

Although it is impossible for riveters working in close quarters, or on watertight work, to develop top speed, even this class of work has been speeded up in all American shipyards by the rivalry stimulated by the contests. Beckel's record of 1,511 rivets at the Staten Island yards, for example, was made with counter-sunk rivets, a much more difficult head to shape than the ordinary button-head rivet, and he was working part of the time in a position where the work was directly over his head. In the Staten Island yards the average for all classes of riveting was formerly 225 rivets a day for each gang. Since the contests began it has increased to 325. "Five additional rivets per gang per hour for all good men in good-sized shipyards means building one 10,000-ton steel freighter in ten weeks," says Chairman Hurley of the Shipping Board. The Board is trying to divert the competition into broader fields, making a month's work rather than a single day's burst of speed the basis for prizes and bonuses. Too many workmen want to drop their own work to watch the speed gang; the latter are too tired to work effectively for a few days after going after a record.

A championship contender and his "bucker-up" (the man who holds the rivet in place while the hammer pounds away) at work in the Submarine Boat Corporation yards where the first high speed record was made. When he is going good the din can be heard distinctly in Berlin thirty-five hundred miles away

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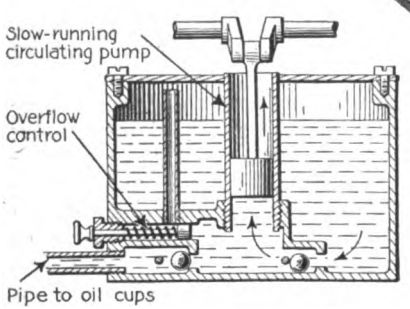
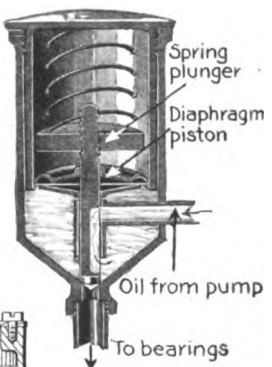
Oiling Your Automobile Without Soiling Your Hands

INSTEAD of having to fuss with oiling your spring shackles, brake-rod connections, universal joints, etc., and get yourself oily and greasy into the bargain, why not make the regular oil pump of the automobile engine do the work automatically for you? This is what H. Hanna, of Sterling, Kansas, seeks to accomplish by the automatic oil cup illustrated herewith. The cup is really the feature of the apparatus, since it can be applied to any car with a force-fed lubrication system as shown in the pictures. The cup is of the dual type with one cup inside the other, the inner cup being provided with a piston and piston rod and a coil spring behind the head of the piston to force it down automatically and squeeze the grease into the bearing to be lubricated.





The pump to the left supplies the oil to the oil cups (above) and the spring plunger does the rest

The piston rod has a groove cut into it near its center to act as a valve to admit the grease as soon as the spring has forced the piston down until the cup is nearly empty. As soon as sufficient grease has been forced into the cup, the piston is moved up in its cylinder to close the valve, after which the lower end of the piston rod acts as a plunger to force the lubricant down into the nozzle of the cup screwed into the bearing to be lubricated.

This method of oiling is not only more cleanly but also more economical than the old one.

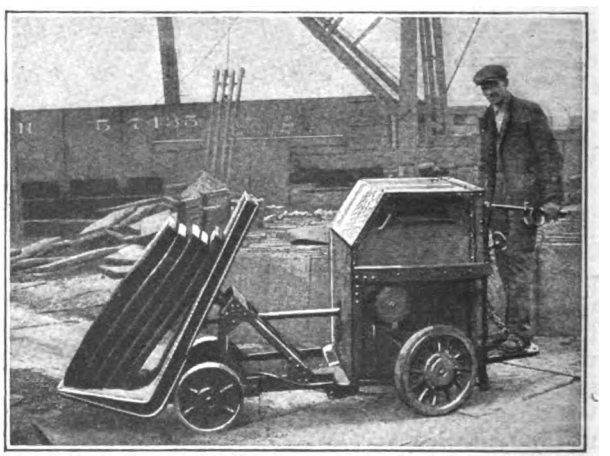
Concrete Ships Contain Forty-Two and One-Half Per Cent Steel

IT has been figured out that in ships built of reinforced concrete the weight of steel is about 42½ per cent. of that in a steel ship. This estimate is based on a ship 205 feet long, 32 feet beam and 19½ feet draft.

How Slabs Are Hauled by Electricity

ONE of the recent devices designed to save man labor is the slab-handling storage battery truck, which is employed at the plant of a steel company in Cleveland to haul heavy pieces of steel from the storage yard to the heating furnaces. The distance approximates five hundred feet. Before electricity was substituted for man-power the slabs were loaded on hand-trucks.

The new truck is similar to the elevating platform truck, except that for its elevating mechanism a tilting platform is provided. This platform is secured to the rear axle by a pivot, being operated by a horizontal ram. By manipulating the ram the platform is moved toward a vertical position and its front edges are lowered.



This truck was designed to take the place of muscle in hauling steel slabs. It is electrically-operated

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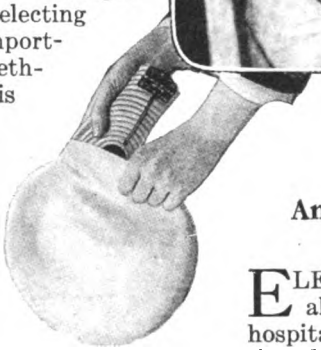
Why You Must Have Two Good Eyes to Be a Flyer

A FAMOUS English physician, Sir Watson Cheyne, in speaking recently regarding the medical aspect of aviation, says that an aviator must have true binocular vision, especially when traveling at great speed, and there must also be a very rapid connection between the sight and the action. In fact, in selecting pilots, one of the most important points to ascertain is whether the binocular vision is good and also the time it takes between the aviator's seeing and taking action. Very often it has been discovered that one eye is not used at all. Many people are going about with one eye and not using the binocular vision.



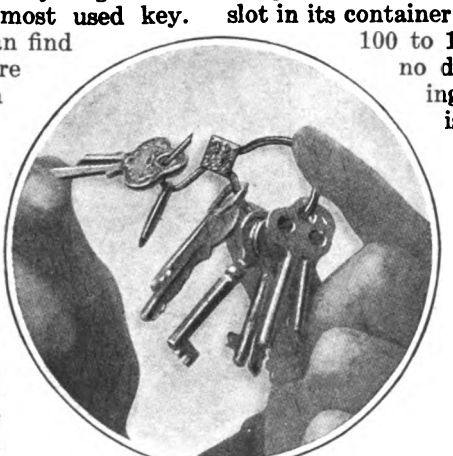
Taking the electric-pad treatment; at the left is shown the construction of the pad

No More Fumbling in the Dark for That Key

HOW many times have you fumbled in the dark for the door key, fingering over half the bunch on your key-ring, picking out the wrong one and burning up a lot of energy in foolish impatience? That has been the common lot of key-bearing humans, but it does not need to be now, since there has been placed on the market a key-ring with a special section for the most used key.

With this ring you can find at once, even while you are drawing the keys from your pocket, the one that you most often need. The ring is so made that keys may be quickly put on or removed from either the special section or main ring.

Had this invention been given to the world when men first began to lock their doors, the saving in time would have amounted to enough to make efficiency engineers wonder as well as emulate.



You don't have to finger over half the bunch on your key-ring to pick out the right key. The most used key is kept in a separate section

An Electric Pad Instead of an Incubator

ELECTRIC heating pads have already proved useful in the hospital; and now a new type, designed for general use, has been put on the market. It is a modification of the hospital type of pad, and contains a thermostat in a sealed box and wound with the continuation of the German silver wire that forms the main heating element. The thermostat heats with the pad, remains at the same temperature, and is therefore independent of radiation for its action. The thermostat, in the center of the pad, is composed of two U-shaped arms of half yard brass and tempered steel. It is adjusted through a slot in its container and has a range from 100 to 180 degrees. There is no danger of short-circuiting even when the pad is wet. A pad of this description has been used in cases where a baby incubator was not available to keep a baby that had been prematurely born comfortably warm for several weeks, with the thermostat set for 100 degrees.

Electric heating pads are made in several sizes for various purposes as needed.

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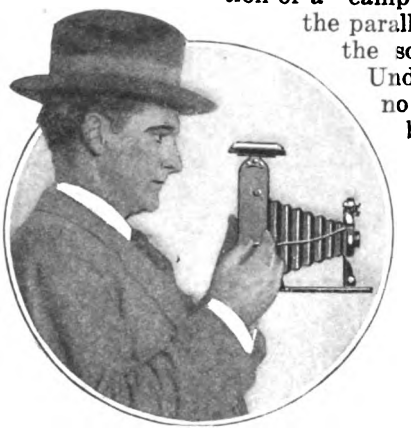
You Can Sight a Camera Like a Rifle with This Finder

MR. C. C. CARPENTER, of Akron, Ohio, has invented a lensless direct view finder which is easily attached and which enables the operator to see his object right up to the moment of exposure.

The new finder is merely a half-cylinder about an inch in diameter, with no lens, attached directly over the lens of the camera to the body of the camera by a tongue and loop. The correct distance for the exposure is obtained by the regular finder or by the focusing scale. Then the object is centered by squinting through the direct finder after the fashion of a gun sight. In this way expressions can be caught, and poses obtained that would be impossible with the regular finder.



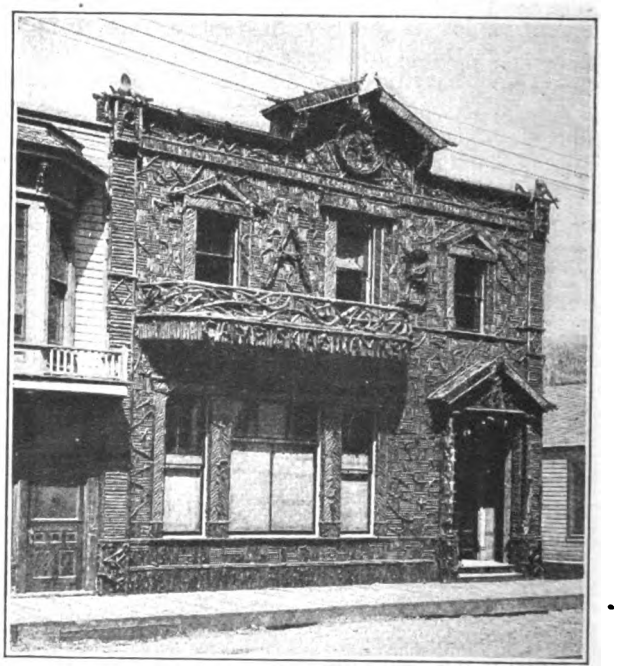
With this direct view finder you can see your object up to the very time of exposure

A Secret Organization Builds a Clubhouse of Driftwood

THE Arctic Brotherhood, whose home in Skagway is shown in the accompanying illustration, is a secret society the rules of which permit the formation of a "camp," or lodge, only north of the parallel 54 degrees 40 minutes, the southern limit of Alaska. Under this rule there can be no initiation of new members except in the far North. Nearly every eminent man who visits Alaska, however, is initiated. Among the members are Rex Beach, former Speaker Cannon, and ex-President Roosevelt. The brotherhood was formed at the time of the Klondike gold fever, when there was more or less trouble between the Americans and the Canadians. The organization maintains camps at Sitka, Fairbanks, Nome, Dawson, White Horse, Skagway and other points.

What Is the Color of a Smell?

CAN we say that a thing has a "green odor," or a "pink smell"? Professor R. W. Wood of Johns Hopkins thinks so. It seems that colors bear a certain relation to odors. This is especially true of gases. Bromine and peroxide of nitrogen, for instance, are both reddish-brown in color, and although chemically different they affect the sense of smell in the same disagreeable manner. The air we breathe is composed chiefly of nitrogen and oxygen, two colorless and odorless gases. But if these two elements are combined in the proportion of two molecules of nitrogen to four of oxygen the odor becomes so unpleasant that we should call it "dark brown" when expressing it in the terminology of colors.



Home of the Arctic Brotherhood in Skagway. The building's ornate front is made of driftwood

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This Machine Will Make the Most Fractious Fraction Behave

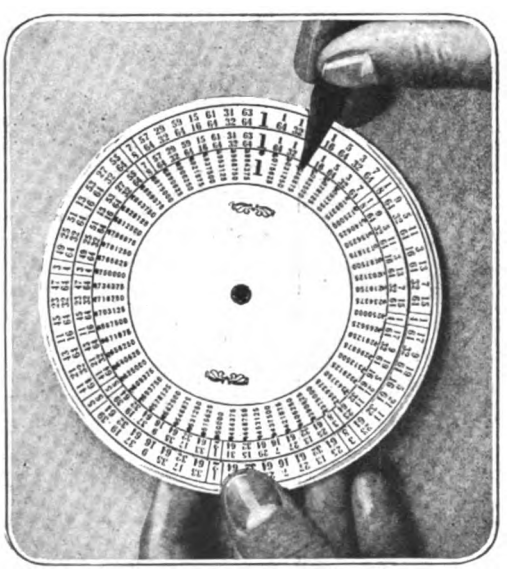
LIFE is to be made easier for accountants and draftsmen by the invention of a device that will add and subtract fractions with a minimum expenditure of brain power.

The device consists of two superimposed disks, one smaller than the other, pivoted at their centers. Two scales of fractions from 1/64 to 63/64 are spaced around the peripheries of the two disks. On the smaller disk, inside the fractional scale, is a row of holes, one for each scale reading, and inside of the holes is a scale of decimal figures which are the decimal equivalents of the fractions.

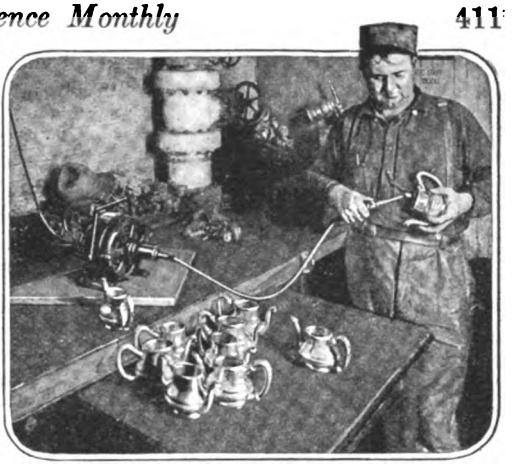
If, for instance, it is desired to add the fractions ⅛, 3/16, 7/64 and 11/32, the first step is to bring the 1's on both disks in line and then place the point of the pencil in the hole under ⅛ on the inner disk and bring it under 1 on the outer disk. Next place the pencil point in the hole in the inner disk, opposite the fraction 3/16 on the outer disk, and bring it under 1 on the outer disk. Repeat this operation for 7/64 and 11/32, and under 1 on the outer disk you will find the answer, 49/64, on the inner disk. Directly below it you will also find the answer in decimals, 0.765625.

In cases where the fractions added total more than 1, the whole number part of the answer is had by observing how many times the 1 on the inner disk has been moved past the 1 on the outer disk. Fractions are subtracted by reversing the method for addition, and combined addition and subtraction by combining the two methods.

The operation of the disk is so simple that a child can do it.



You may be the poorest of mathematicians, but the toughest problem in fractions is easy if you have this little disk



Meet Mr. A. L. Barth, whose job in life is to massage out wrinkles in the dining-car silverware of the Union Pacific Railway

Removing the Dents Caused by a Fast Life

THIS is a silverware hospital with A. L. Barth as surgeon. He is called a repair man instead of doctor; his operating room is the Union Pacific Railroad's repair shops at Omaha, and his patients are the silver pots and bowls bearing the dents and scars of their strenuous dining-car life. How to make them presentable was a problem until someone hit upon the idea of an electric hammer with a small, rotating, oval head. Applied lightly to the dent on the inside, the hammer, in skilful hands, rapidly massages away the hurt and leaves the outer surface without a mar.

A recollection of the juggling feats of the colored waiters leads us to believe that the silver repairman seldom has to complain of lack of business, though we are not told how often the railroad silver has the rest cure.

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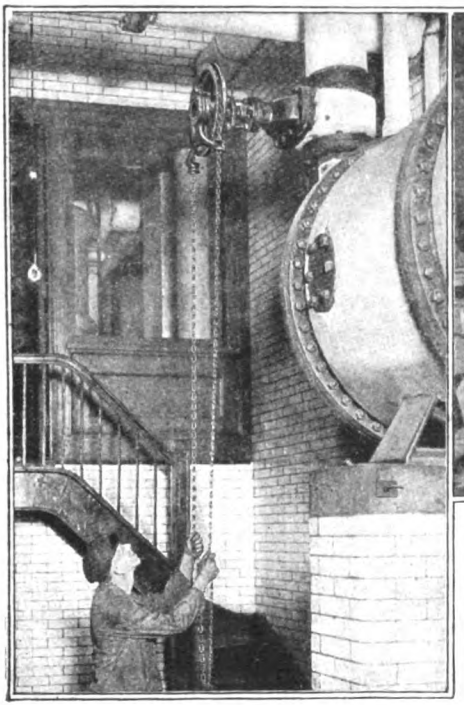
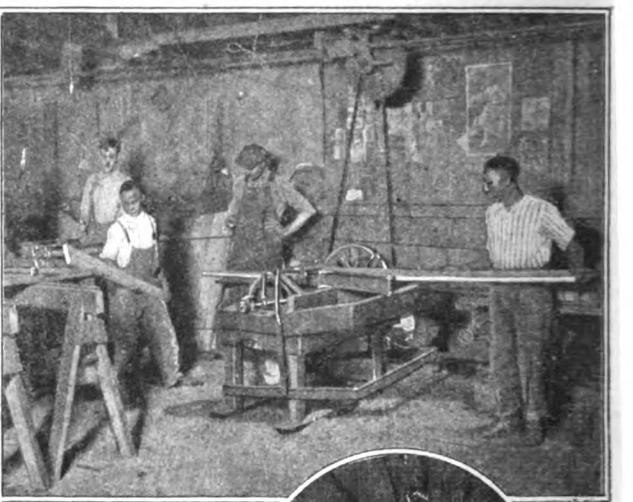
Do It with Tools and Machines

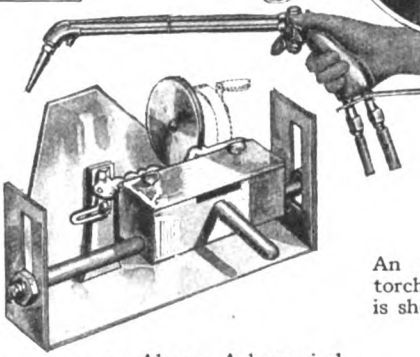


Valves placed in pipe lines overhead in inaccessible places may be easily operated with this rim and chain from the floor below



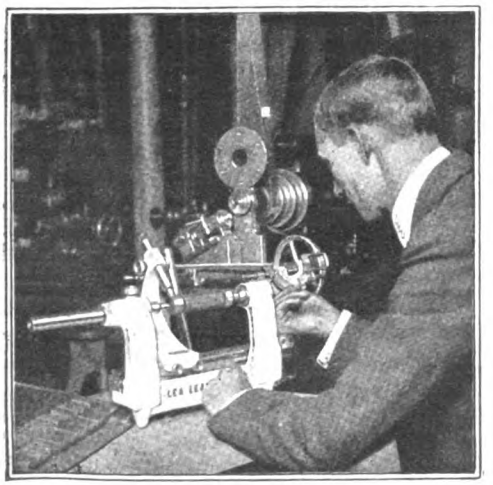
Both edges of a board may be glued at the same time for making table tops and other things

A single unit steel-jacketed electric heater that can be installed single or in multiple in narrow confined places



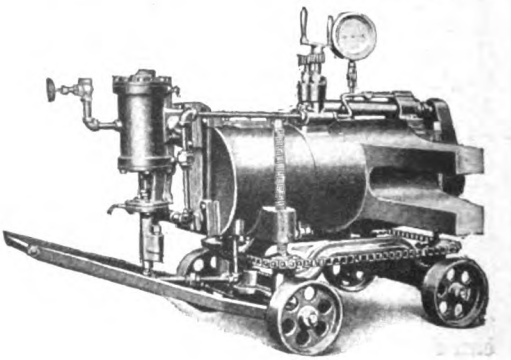
An oxy-acetylene welding torch controlled by one hand is shown above, to the left

Perfect threads are essential to the accuracy of fine machinery. Below is shown a micrometer thread-lead gage that measures and detects the slightest bit of inaccuracy



Above: A key grinding rig in which the master key guides the grinding wheel

Below we have a portable press for forcing crank pins into the wheels of locomotives and of engines



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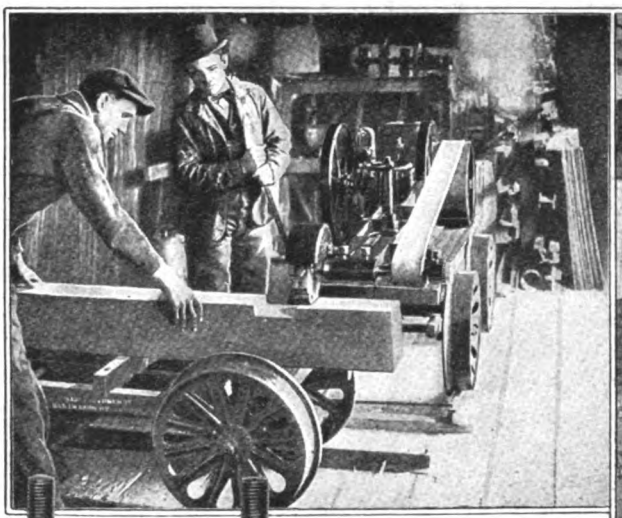
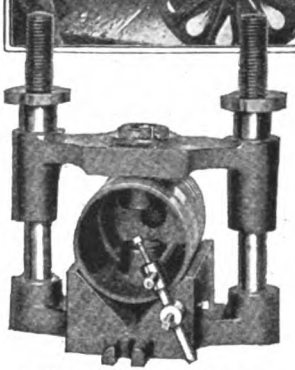
Do It with Tools and Machines

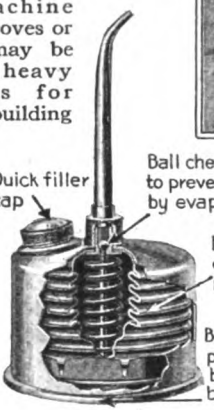


With this powerful machine large grooves or dados may be cut in heavy timbers for bridge building

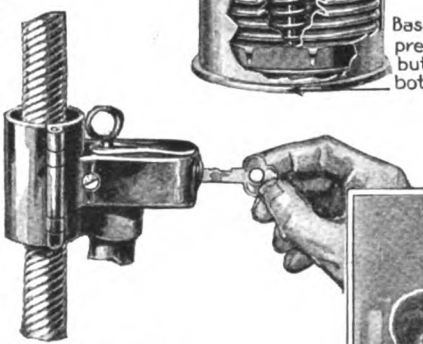
An electric hoist with a special hook or grip to handle heavy, unwieldy barrels in storing or loading



A jig to hold a piston in boring and reaming for wrist pins

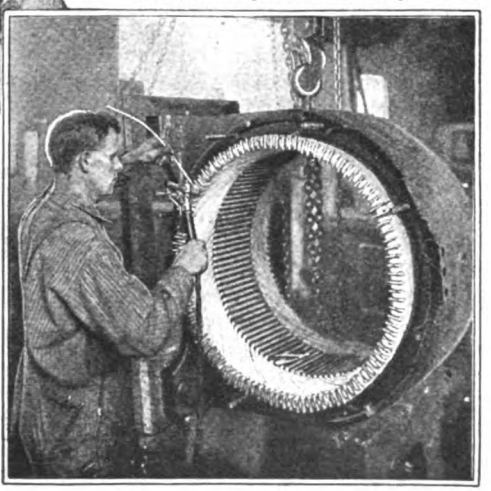


The metal bellows oil can, shown in center, draws the oil in after the squirt



At the right, a clamp and lock for an elevator control cable

An electric soldering iron is shown below in which two carbons keep the iron always hot



A three-wheeled shop truck in which the leading wheel can be used with other trucks

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Making the Safety Zone Post Resilient and Safe

AFTER his auto had bumped a few safety zone posts, resulting in disfigurement of both post and car, Stanley Kempner, of New York city, hit upon the idea of using rubber in place of iron for the post rods. In his invention the base of the zone post is iron, as in the ones commonly in use, and the plate—where one is used—bearing the "Safety Zone" sign, is also of metal, but the connecting rod is of hard rubber. When the post is hit the rubber rod bends, only to snap silently back into place again when the offending car has backed away, and neither car nor post is the worst for the accidental encounter.

If this were a rubber post instead of an iron one neither car nor post would get much of a shakeup from the collision

Mr. Kempner believes that the general adoption of his post would decrease the number of street accidents, since drivers would be quicker to risk running into the posts when facing the alternative of hitting a post or a pedestrian.

Twenty Miles an Hour Is the Most Economical Touring Speed

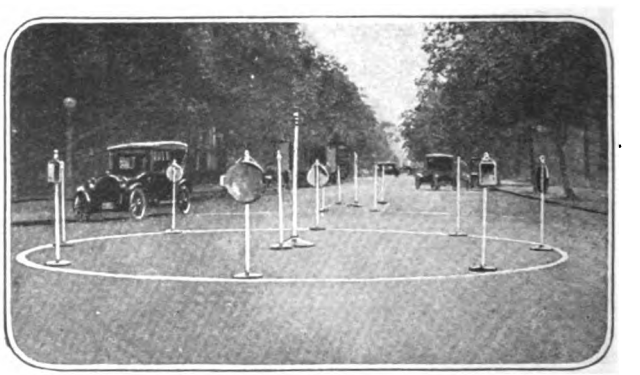
AS the automobile touring season is now in full swing it may be well to remind the autoist of the proved fact that the most economical touring speed is from twenty to twenty-five miles an hour. Fast driving on tours means increased fuel consumption, greater strain on the car and its occupants as well as lower mileage. Moreover, the Government, desirous of conserving gasoline for war purposes, discourages extended pleasure tours; so that not only the motive of thrift, but also of patriotism, should urge the speed maniac to slow up.

Washington May Get Along Without Traffic Policemen

TO avoid congestion at busy street crossings in Washington, D. C., a new system of "rotary traffic" has been adopted. The purpose of it is to prevent any "left turns," and automobiles must go around the circle marked on the pavement, when they want to shunt off in that direction.

The entire crossing is plainly marked out with this rotary scheme, circles and straight lines being laid out in geometrical fashion to indicate where motor cars and pedestrians are to move. Small arrows are part of the scheme and no driver has any excuse for not knowing the rules. All he has to do is to keep his eyes on the ground.

These crossings are further decorated by a series of sign posts, placed at each intersecting point of the lines on the street. These set off the points of contact of the circles and the straight lines. This system has been found to operate very successfully, even without the supervision of a traffic policeman. It has been quite generally adopted throughout the capital city, where wide streets and numerous parks contribute to its success.



No policeman is necessary to prevent traffic tangles at Washington crossings guarded by these silent monitors

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Caring for the Teeth of Our Soldiers

Because an army fights with its teeth as well as with bullets

"Do I have to eat the Germans?" asked the recruit who was rejected because of bad teeth in the early days of the war. Now the army takes him and repairs his biting machinery

FOR the first time in history the American Government has assumed supervision and control of the teeth of the Army and Navy. In full recognition of the importance of sound teeth the military authorities pay careful attention to the condition of the teeth of the volunteers and drafted men who present themselves for examination as to their fitness. Men with hopelessly bad teeth are rejected and those with less serious defects are turned over for repairs to the dental department. When soldiers were expected to bite off the ends of their cartridges and when soldiers and sailors alike were expected to subsist principally on "hard tack," it used to be the policy of the Government to reject men with poor teeth from army and navy, but no effort was then made to correct minor defects and to keep the teeth of the men in good condition.

A man without teeth or with teeth that are decayed or otherwise defective cannot chew properly. He is a mark for indigestion. Moreover, his decayed teeth may harbor germs, the presence and activity of which may produce diseases of a serious nature. But, if we must have an army, it should be efficient. It does not pay to maintain an inefficient army. For that reason it is good policy for the Government to assume parental care of the teeth of its soldiers and sailors.

In the big camps where recruits are prepared and trained for service at the front, dental departments have been established. The large dental hospital at Camp Meade, Md., is typical. It is a large, plain structure of wood, with double walls, large windows and adequate ventilation. It is supplied with running water and electric light and power. The apparatus is of the most modern kind. Chairs, rests, trays and other parts of the equipment are of metal coated with white enamel, or of glass. Electric motors supply the power for the drills, polishers and other rotary instruments. By the side of each chair is a white-enameled cabinet containing a full assortment of medicines and dental instruments and supplies.

The teeth of the recruits are carefully examined from time to time, and if they show any defects the men are sent to the dental hospital where these defects are promptly remedied.

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Blow Your Megaphone-Whistle to Proclaim Your Patriotism

AN Eastern novelty concern has placed in the market a new instrument of torture. We suppose that it must be classified as a musical instrument. It is a megaphone whistle which sounds both "coming and going," like the reeds of a mouth harp. It will produce noise enough to satisfy the most patriotic youngster.

The surface of the megaphone cone is colored red, white and blue, and shows a blue star in the white field in token that the noise-making youngster has some member of his family in the service of his country.

It is a megaphone-whistle that sounds both "coming and going" like a mouth harmonica

How Can We Save Potash Now Wasted in Smoke?

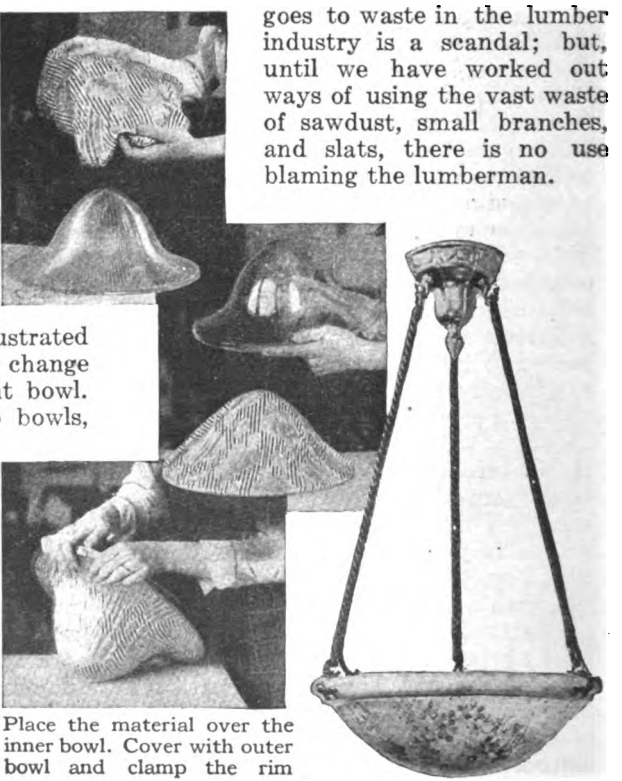
DR. CURTIS H. THWING, of the University of Washington, has been examining the ashes found in the incinerators of lumber-mills in the Northwest, with a view to conserving the potash salts from them. He found that the flue dust contained only about seven per cent of potash. The reason for this slight proportion was that the type of incinerator in use calls for a strong draught, and this causes much of the potash to go off in smoke. Dr. Thwing did not see how the present incinerators could be improved with the present methods of lumbering.

The amount of wood that goes to waste in the lumber industry is a scandal; but, until we have worked out ways of using the vast waste of sawdust, small branches, and slats, there is no use blaming the lumberman.

Change the Electric Light Bowls to Suit Your Taste

SOMETHING new in electric light fixtures has been placed upon the market, that will greatly please women, who often wish to change the color scheme of a room, perhaps for one evening. This, of course, includes the light globes, and new globes are expensive.

The invention referred to and illustrated here makes it a simple matter to change the color or decoration of the light bowl. In the new device there are two bowls, one inside of the other, held together by a brass rim. Silk or any other kind of material, colored or decorated to suit the taste, may be placed between the two bowls, so as to bring the fixture in harmony with the color scheme or the decorative plan of the room. The new fixture is made with bowls of different shapes and styles to furnish the variety that is the spice of life.



Place the material over the inner bowl. Cover with outer bowl and clamp the rim

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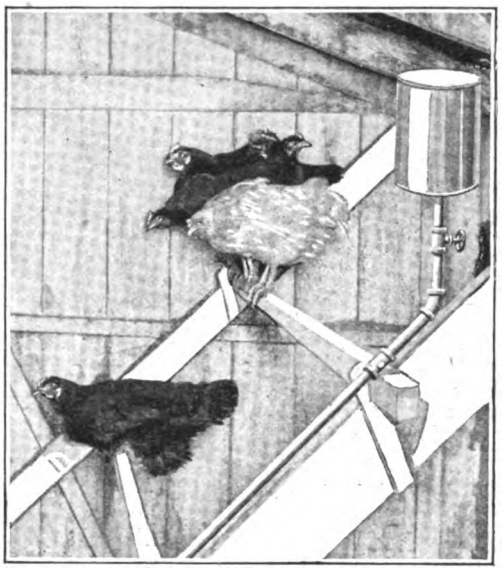
Good-bye, Axe! They Chop Down Trees with Gasoline Now

AN automobile truck comes to a stop among the big timber. Two men lift a heavy framework of iron rods and pipes from the truck, while two other men drive four stakes at equal distances around the base of one of the giant trees and connect each pair by nailing planks to them at a height of about two feet. The iron framework is put together, fitted around the tree and placed on top of the parallel planks. Then an arrangement of wheels and rollers is put in place and adjusted, and finally an endless steel bandsaw of peculiar construction is placed around the wheels and between the rollers. The wheel on one side is connected with a gasoline engine and when everything is in readiness the engine is started going.

The wheels begin to revolve, and as two of the men slide the frame towards the tree, the rapidly moving saw begins to scream while its teeth cut into the wood. In a few minutes the work is completed.

That's the new way of felling trees with neatness and despatch.

The accompanying illustration shows the construction of the sawing device. The teeth of the saw are all "set" to one side, but the divergent "set" required for cutting is obtained by combining the upper and the lower runs of the saw.



Vermin-proof perches are the up-to-date improvement for hen houses

Making the Perch Sanitary for the Hen

HOW to make hen houses vermin-proof has been solved by a Michigan man who has invented a hollow perch containing germ-killing disinfectants which seep through and destroy all hen-troubling pests. The perches are connected with a gravity supply tank holding a gallon of the disinfectant and each perch has a dripping plug to regulate the flow.

The husky wielder of the axe gives place to the engine-driven bandsaw; the work of half an hour is done in a few minutes

What Makes an Airplane?

INCLUDED in the materials necessary for one airplane are: Nails, 4,326; screws, 3,337; steel stamping, 921; forgings, 798; turnbuckles, 276; wire, 3,262 feet; aluminum, 65 pounds; spruce, 244 feet; pine, fifty-eight feet; ash, thirty-one feet, hickory, one and one-half feet; varnish, eleven gallons; dope, fifty-nine gallons; rubber, thirty-four feet; linen, 201 square yards; veneer, fifty-seven square feet.

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Breakfasting on Poi

It is made from taro and has been the food of primitive people for centuries

By A. M. Jungmann

The Taro Plant

Taro plants are not grown from seeds. In fact, the plant produces flowers rarely. The flowers, when they do appear, resemble the calla lily, with the exception of the fact that they are yellow. The plant grows from one to five feet high

NOW that the entire civilized world is occupied with the question of food production, let us consider taro, perhaps the very first crop raised. Taro is a plant that grows wild in Polynesia, the Malay Archipelago, and India. The very earliest of those daring European navigators who voyaged on untraversed seas found taro cultivated from Japan to New Zealand.

The taro root is very like the yam, or sweet potato. Besides being made into poi, it is frequently used as we use potatoes. The nutritive value of taro is similar to that of the potato. It contains 18 per cent of starch, 1.75 of sugar, and 1.80 of protein. In our own Philippines, modern factories turn taro roots into "poi." Wash the taro roots and then grind them into powder and you have poi. The meal is a delicate pink or lavender color. It is not only highly nutritious, but is so easily digested that it is an ideal food for young children or invalids. It is an

Poi-Eaters' Dance

The dancers, after eating poi, sway back until they are reclining on the floor, then sway forward again

This Is How Taro Grows

Hawaiian taro is planted somewhat as we plant potatoes—that is to say, in hills and rows. The rows are placed from one to three feet apart, and a small ditch is run between every five or six rows in order to keep the moisture of the earth uniform. These ditches are filled with water after the taro has been planted several days. The taro itself cannot be flooded, because, if a patch is flooded too soon, it is likely to rot

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excellent substitute for cornmeal, farina, and other cereals. In the tropics a porridge is made of poi by adding the meal to hot water and stirring it constantly until it has the consistency of paste. It may be eaten with salt or sugar, butter or syrup. It would undoubtedly be welcome on American breakfast tables, if eaten with cream like other cereals. In the Far East taro roots are cooked and eaten like potatoes, or diced and baked with rice flour.

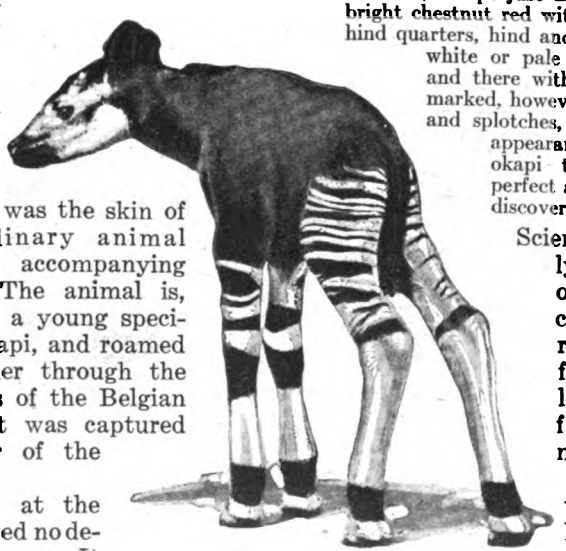
The Poi-Pounder, Showing Primitive Method

When the harvest has been gathered, the taro is boiled for several hours. When it has been boiled sufficiently it is placed in boat-shaped trays and beaten with a stone implement known as a poi-pounder. It is necessary to moisten the taro during the process of pounding. This is done by moistening the stone-pounder. When the substance is of a dough-like consistency, it is called paiai. This is pounded again, a little water added, and the pounding continued until the substance becomes fine and smooth, when it is poi

The Okapi's Coat Outshines Joseph's Coat of Many Colors

ONE of the most precious trophies which Mr. Herbert Lang, of the expedition sent by the American Museum of Natural History to the Belgian Congo, brought back to New York, was the skin of the extraordinary animal shown in the accompanying illustration. The animal is, or rather was, a young specimen of the okapi, and roamed with its mother through the tropical forests of the Belgian Congo until it was captured by a member of the expedition.

It remained at the camp and showed no desire to run away. It did not live long, however, and died after two weeks, to the general regret of the members of the expedition.



This creature, which looks like a composite of half a dozen different animals, is a young okapi imported from the Belgian Congo

The first white man who had the good fortune to see a living okapi in its native habitat was Sir Harry H. Johnston, Special Commissioner for Uganda, British East Africa; and he gave the first detailed description of that rare animal:

The coloration of the okapi is quite extraordinary. The cheeks and jaws are yellowish white, contrasting abruptly with the dark colored neck. The forehead is a deep red chestnut. The large, broad ears are of the same tint, fringed, however, with jet black. The forehead ranges between vinous red and black in tint, and a black line follows the bridge of the nose down to the nostrils. The muzzle is sepia colored, but there is a faint rim or mustache of reddish-yellow hair round the upper lip. The neck, shoulders, barrel, and back range in tone from sepia and jet black to rich vinous red. The belly is blackish, except just under the knees. The tail is bright chestnut red with a small black tuft. The hind quarters, hind and fore legs are either snowy white or pale cream color, touched here and there with orange. They are boldly marked, however, with purple-black stripes and splotches, which give that zebra-like appearance to the limbs of the okapi that caused the first, imperfect account of it to indicate the discovery of a new striped horse.

Scientists have been greatly interested by the okapi, and have decided that it is closely related to the giraffe family, but really belongs to a separate family, which they have named *Okapia*.

Those who have seen the okapi in its native habitat, roaming in the underbrush, assert that its protective markings make it difficult to distinguish the animal.

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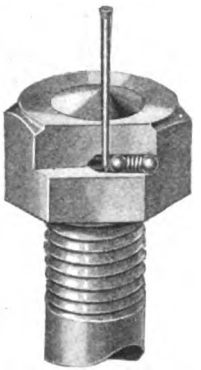
Use a Nail to Unlock the Nut of This Bolt

THE nuts of screw bolts used on high-speed machinery invariably have a tendency to work loose. No matter how well they are made and how tightly they are screwed down, continuous vibration will sooner or later loosen them. Unless their looseness is ascertained in time and they are tightened again, the nuts may work loose altogether and the dropping out of the bolt may wreck the machinery. Many devices have been invented for locking nuts in position after they have been tightened, but few of them have given satisfaction.



The harder you try to unscrew this unique nut the tighter it becomes

Recently a manufacturing concern in Detroit placed in the market a remarkably clever device in the form of an automatically locking nut. Into the side of the nut a hole is drilled obliquely toward the inside thread, so that a slot-like opening is formed. A specially hardened steel ball, backed by a spring, is inserted in the drill hole, which is then closed. When you try to unscrew the nut, the steel ball, which is pressed against the thread of the bolt by the spring, is wedged in the thread and tightens the nut to absolute immovability. To unlock the nut, a finishing nail is inserted in a small hole that runs at right angles to the groove in which the locking ball moves. A slight tap on the head of the nail will release the wedged steel ball and hold it away from the thread. The nut can then easily be removed.

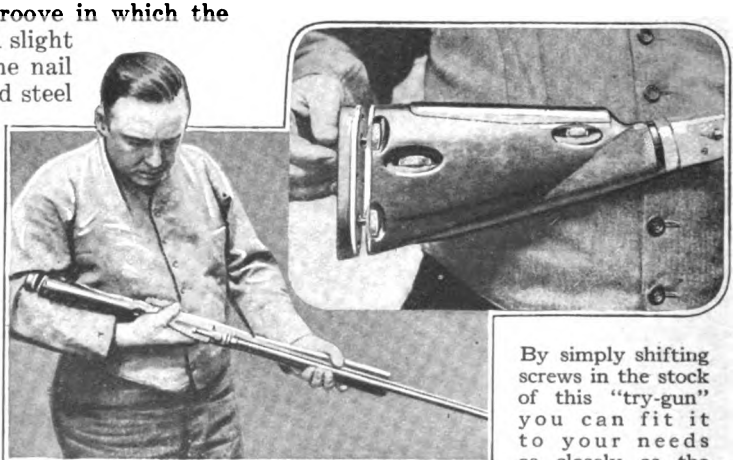
The construction of this nut, which is made in all standard sizes and threads, is extremely simple. There are no loose parts that could be lost or that would easily get out of order, and it works perfectly.

Fitting the Gun to the Man Who Shoots It

IF you are particular you had better get measured for your gun. The "try-gun" shown in the pictures below was invented for that very purpose. It is made with joints, screws, and bolts that permit you to change the length of stock, the "drop," and the "cast-off" as you choose. This one is the product of a celebrated American gun-maker and is the most highly developed of its kind. Here's what the fitter can do in making the gun exactly to your measure:

Increase or decrease the length of stock; alter the "drop"—the distance of the stock below the line of sight or top of barrel—at both comb and heel; change the "cast-off"—the lateral departure of the stock from the line of the bore of the gun; and change the pitch of the butt plate—the distance from trigger to heel and to toe of butt plate.

On one day at the traps this gun was used by a man who required its utmost length of stock—15½ in.—and another, a less husky gunner, who shortened the stock to 13½ in. Neither man knew just what he wanted or needed until he had gone through the fitting process.



Heine Pfirrmann, Jr., a noted California trap-shot, tried out the "try-gun" and found he could get a perfect fit

By simply shifting screws in the stock of this "try-gun" you can fit it to your needs as closely as the tailor fits your coat

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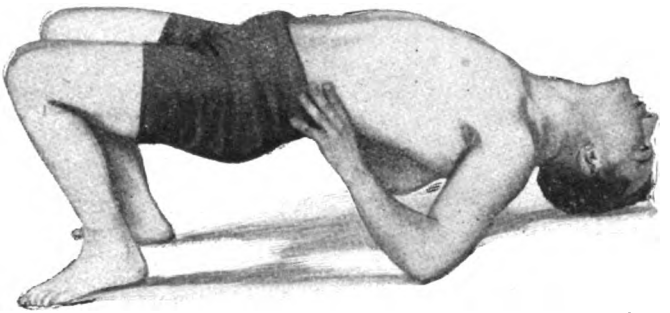
A Beetle That Does a "Flip"

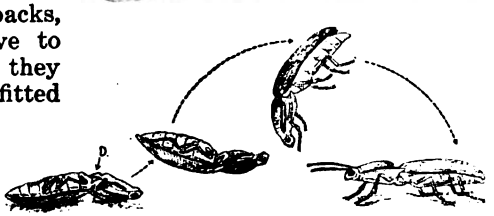
Alaus oculatus would be a great circus performer

By Dr. E. Bade



A circus performer could never perform a "flip" if he were required to start from this position

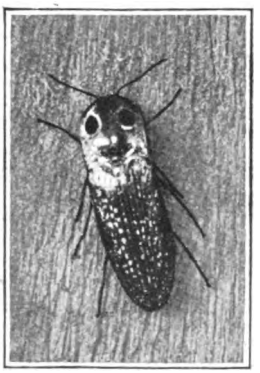
THE beetles of the Elateridae family are distinguished by their comparatively short legs. This is a handicap, for they cannot right themselves with their legs, as other beetles do when thrown on their backs, and they would have to remain lying where they fell if they were not fitted with a peculiar jumping device by which they right themselves.



A beetle doing its great jumping act. The acrobat's effort is tame in comparison

When the beetle is tumbled over on its back its first attempt is to get into contact with some object immediately above with its short legs. Failing in this, the beetle arches its back so that only the neck-shield and the wing covers touch the ground. Then a slight click is heard, the beetle hurls itself upward, turns over in midair, lands on its feet, and goes on its way.

When the back is arched only the front part of the neck-shield and the back part of the wing covers touch the ground. Looking closely at the beetle, we find a thornlike projection growing from the middle of the ventral side and attached to the first abdominal segment tightly pressed against the rim of a depression found on the second abdominal segment. When the muscles of the body are suddenly contracted the thornlike projection slips with a sharp click from the rim into the depression. By this action the abdomen is thrown upward with such force that the beetle is lifted bodily into the air.



This is the jumping beetle, otherwise alaus oculatus

A few beetles of the Elateridae family (of which more than 3,000 varieties are known) have been known to jump more than one foot in this manner, and they seldom fail to land on their feet. Should the first attempt fail the jump is repeated until it is successful. So you see the Elateridae family might be billed in the circus any season—name and all—for by comparison the "mat work" of the human performer is tame indeed. To be sure the circus tumbler can lie at full length and then "snap up" to his feet, but he couldn't do it if he were required to start from a position with head and heels touching the mat.

The larvae of the larger Elateridae prefer to live in the wood of dead or decaying trees. The smaller varieties devastate whole fields of potatoes and other vegetables, as well as destroy grain of all kinds.

The large and beautiful jumper alaus oculatus is an inhabitant of the Eastern States, and is found during the months of July and August. The whole body of the beetle seems to be covered more or less with a white powder. On the cephalothorax are two large, round black spots fringed with white.

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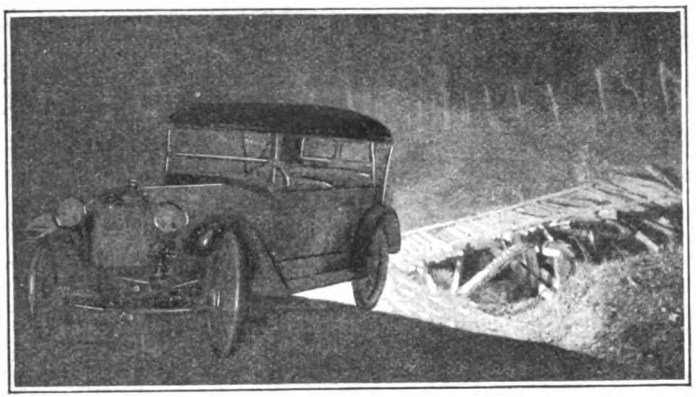
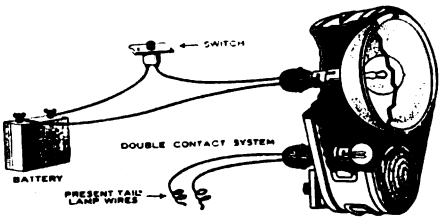


A searchlight in the rear of the car is very useful in a case like this. The wiring is simple



A Tail Light and Searchlight Too

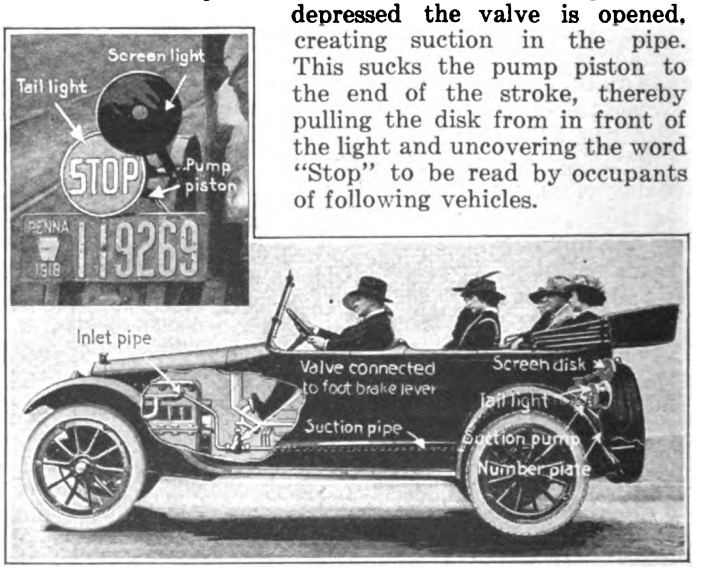
MANY accidents which happen to automobiles when backing up at night could be avoided if every car were equipped with the new combination of tail light and searchlight shown in the accompanying illustrations. It contains in one casing a regulation red danger signal and above it a powerful searchlight electrically controlled from the driver's seat. The device was invented as the result of a car's backing down a road embankment at night in an endeavor to turn around. Besides eliminating accidents of this nature by throwing a flood of light behind the car, it is also just as useful when backing into a garage door or against a curbstone, for which contingencies it is almost as necessary to have lights behind as in front when going forward.

The lamp may be wired for either the single-or double-contact system, and is very simply constructed as shown in the drawing.

"Stop!" It Shouts to the Car Behind

THE rear automobile signal device shown in the illustrations below is automatic in action and is manipulated through the suction of the car engine, as the brake pedal is depressed to slow down or stop the car. The signal consists of a ruby red tail light with the word "Stop" in white letters and a circular black disk with a small hole at its center.

Ordinarily the disk covers the word "Stop," the red light showing to cars behind through the hole in the disk. The disk is mounted on a small rod fastened to the connecting rod of a small suction pump mounted behind the light. This pump is operated by connecting a small three-sixteenth-inch pipe between the intake manifold of the engine and the pump. The pipe is fitted with a valve near the brake pedal, so that each time the pedal is depressed the valve is opened, creating suction in the pipe. This sucks the pump piston to the end of the stroke, thereby pulling the disk from in front of the light and uncovering the word "Stop" to be read by occupants of following vehicles.



When the car slows up or stops the "Stop" signal is automatically displayed to warn other vehicles

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Meatless Meals for Men Who Handle Meat

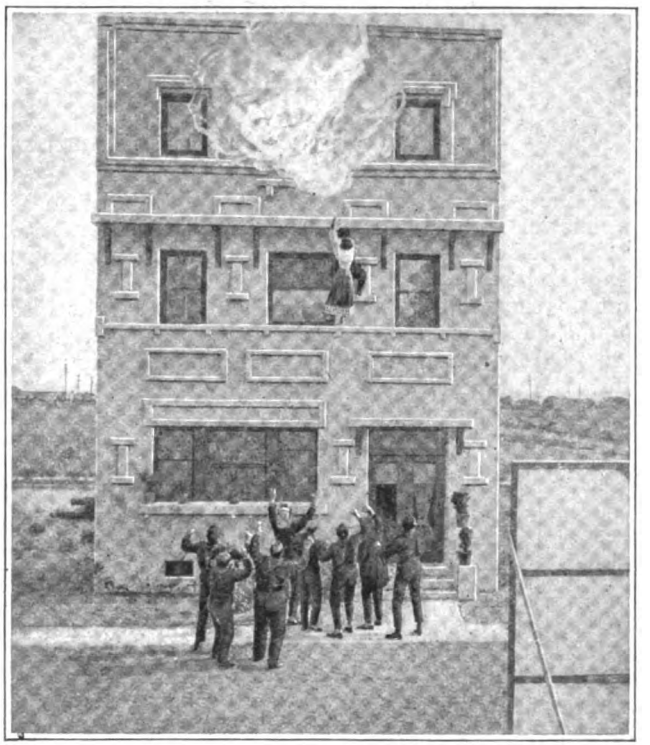
ACCORDING to a bulletin issued by the Food Administration, meatless luncheons are now served in the employees' dining room of one of the largest meat-packing concerns in the Chicago stock yards. Between 1,200 and 1,500 people are served daily, the menus including eggs, fish, oysters, mushrooms, cheese, milk, ice cream, beans and other proteid foods, together with a wide range of fruits and vegetables.

The Ground Floor Becomes Second Story

THE owner of a one-story frame house in Waco, Texas, desired to add another story. He found that a large part of the cost would be the expense of tearing off the roof to add another story, and rebuilding the roof. To save this expense—and also time—he had the entire house raised some fifteen feet off the ground and built the new story underneath. A slight change in the floor plan of the old house converted it into the second story of the new one.

You'd never guess that the house hadn't been first planned this way

The bungalow is on the way up to make room for a new story below



You don't have to be a Douglas Fairbanks to escape from a burning building with convenient ornaments for steps

Built to Enable the Heroine to Escape When It's Burning

IN the foregoing illustration both the house and the frightened lady clutching Fireman Charles Chaplin are products of art—one being a plaster front and the other being made of straw, and dressed to look "very much of a lady."

The photograph illustrates a simple ladder device that is used frequently in taking moving pictures. The various decorations and projections, as here shown, form a very serviceable and convenient set of rungs, by which one can clamber up the face of the building at will. The screen throws light on the scene, while the excitement of the men on the ground imparts a touch of realism.

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Training the Anti-Aircraft Gunner

Why not use free balloons shaped like airplanes?

By Carl Dienstbach

IN the good old days when Wild West shows instead of motion pictures thrilled the youngster who yearned to lead the life of a scout cunning enough to outwit the wiliest Apache, Buffalo Bill would gallop around the tanbark ring, preceded by a rider who tossed glass balls into the air. Raising his trusty rifle to his shoulder, Buffalo Bill would fire at the balls tossed up in front of him, if not exactly with unerring aim, at least with an accuracy sufficiently startling to make every small boy on the bleachers put his two fingers to his mouth and whistle in joyous admiration.

Firing at an airplane with an anti-aircraft gun is about as hard as shooting at glass balls from horseback. Therefore, it has been suggested that the anti-aircraft gunner be trained by making him fire at small target-balloons shaped like airplanes.

No gunner needs so much practice as he who aims at elusive bomb-droppers. If the formerly inefficient anti-aircraft guns have become formidable, it is due entirely to experience gained in three years of warfare. What may not be expected of systematic preliminary practice?

Some Objections to Balloons

It may be objected to the target-balloon scheme that the drift of the free balloons is much slower than the flight of a modern airplane. To this it may be replied that the smallness of the targets makes up for their slowness. Moreover, if they are sent up on a stormy day their drift may become as fast as sixty or seventy miles an hour.

To make target practice of this kind as realistic as possible, it would, of course, be advisable to shape the balloons somewhat like airplanes. This plan is now followed in training air gunners to fire at balloon targets towed from airplanes.

It is possible that even tissue paper bags floated by an alcohol flame might answer; but they could hardly attain great altitudes.

The only real objection to the plan is the fact that in order to attain a great altitude it would be difficult to release the balloons so that they would actually drift into the range of the guns. After all, time enough must be given to them to reach a high altitude. There is also the difficulty that the real problem of aerial gunnery is that of determining how much time must be allowed for the speed of the airplane so that the projectile will actually hit it. It would never do to aim at the airplane where it is at the moment; it must be aimed at where it will be five or seven seconds hence. If it were possible to attain a great height with free balloons while they are still within range, even the smallness of the target would not sufficiently make up for its relatively slow motion. The gunner does not get true practice in making the proper time allowance.

Why Not Use Dirigibles?

A plan that offers much better opportunity for practice to the anti-aircraft gunners would be to send up a swift and powerful dirigible balloon and let it tow a whole string of aerial targets, either balloons or kites, at the desired distance and height. Even when handicapped by the resistance to the air of the towed balloons or kites a dirigible could attain great speed, particularly when going with the wind. In that case, it could reach airplane velocity.

The weight of the towing cable would not prevent a powerful dirigible from rising to a great height and the cable could be made long enough to insure the safety of the dirigible from stray shots. The conditions, being under almost perfect control, could be sufficiently varied at will to give to the gunners ample opportunity to obtain a thorough training in estimating distances, angles and the necessary time allowances in placing shots at moving targets. Kites, of course, would be the most economical targets.

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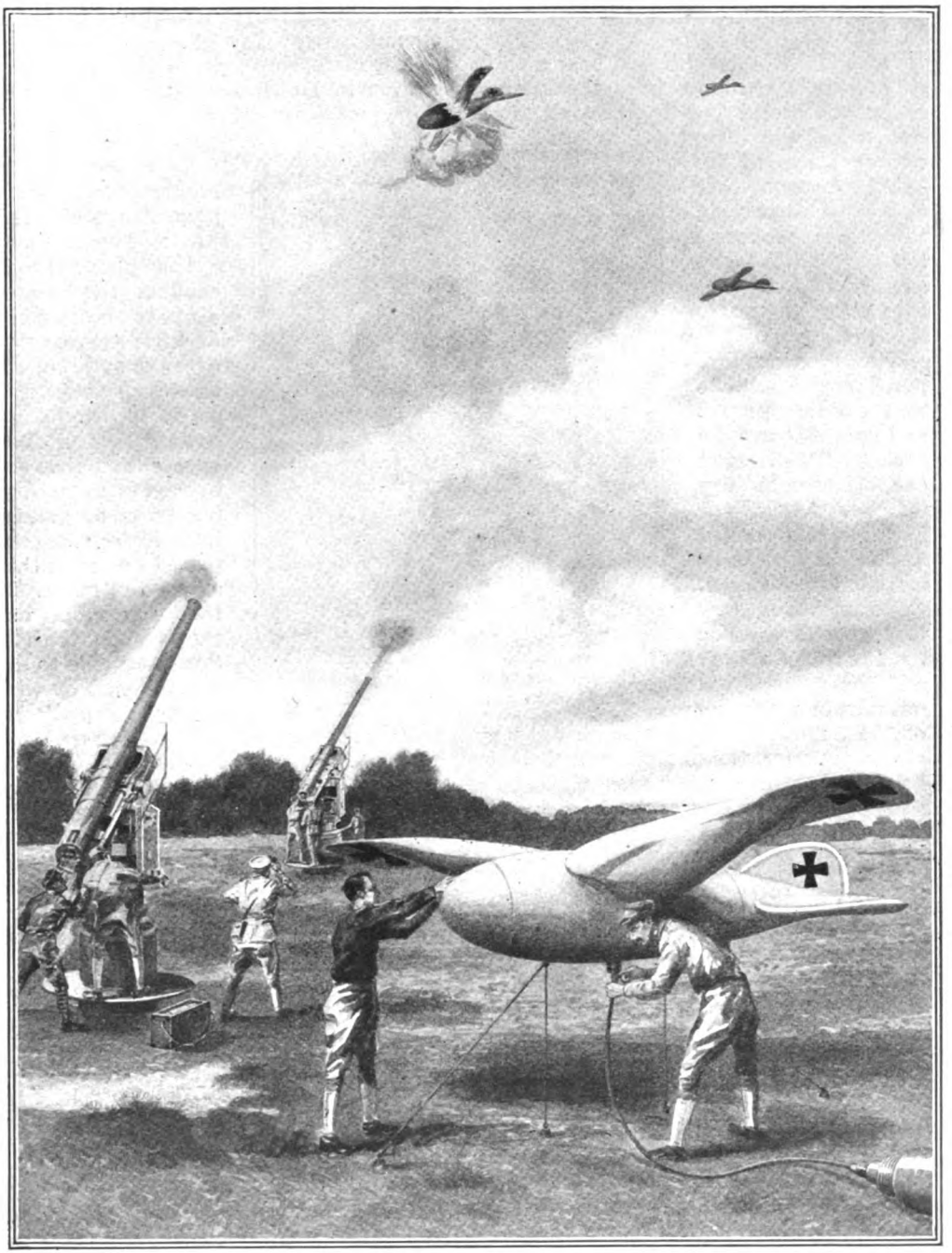
Trap-Shooting with Anti-Aircraft Guns



Trap-shooting is an excellent training for bird-hunters. Shooting with an anti-aircraft gun at an airplane is somewhat like shooting with a shotgun at flying ducks or snipe—only more difficult. Anti-aircraft gunners need previous training even more than bird-hunters. Why not let them go through a course of modified trap-shooting, with balloons shaped like airplanes as targets, instead of clay pigeons? Another plan would be to let them shoot at balloons or kites, towed with great speed by powerful dirigibles

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A Whistle Sounds When the Cooking Water Runs Low

DON'T be startled if you hear a shrill whistle sounding from the kitchen where the dinner is being cooked. It is not a call for help nor an alarm of fire—only a signal that the water supply in the steam cooker is low. The whistle sounds fifteen minutes before the water is entirely gone.

The food is prepared as it would be for the ordinary stove and placed in the cooker. The food cannot scorch, dry up, over-cook, or burn. It is cooked in the same utensils in which it is served. Vegetables and custard may be set side by side in the cooker and the custard will not take on the flavor of the onions. The cooking is done by steam pressure, the nutriment and flavor being cooked into the food.

The food is cooked by steam. A whistle blows when the water is too low

The cooker can also be used for canning foods.

Make Waste Hot Air Work and Conserve Both Fuel and Food

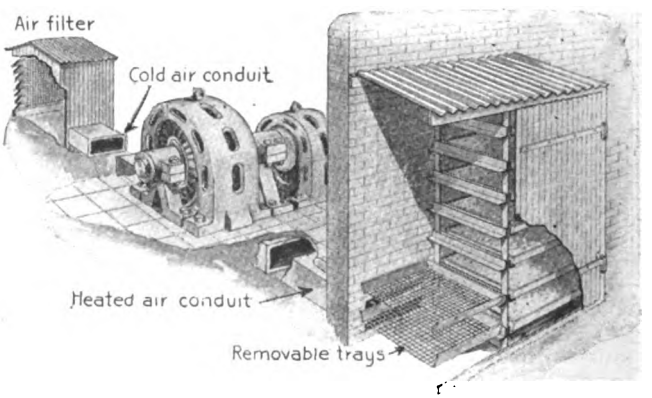
THE heat generated by the running of the alternators has always been a source of annoyance to the station engineers of light or power plants. The degree of heat produced depends upon the amount of work done by the alternator and is usually more than sufficient to soften insulations and to cause other troubles.

It is necessary to cool the alternator by forcing a stream of cool air through the casing. The cool air is first drawn through a filter, then conducted to the alternator. By circulating around the alternator the air becomes heated, and it is then allowed to escape through a suitable shaft or opening.

Mr. Fietz, the engineer of an electricity station in Duisburg, Germany, realizing the great waste it means to allow this heat to escape unutilized, conceived of an exceedingly simple plan of avoiding this waste of heat.

His plan was to conduct the heated air to the bottom of a drying press, erected over the outlet of the hot-air shaft and utilize it to dry a large quantity of fruits and vegetables arranged in layers upon drying trays of galvanized iron wire and placed on shelves one above the other. In this way Fietz and the men in the station were able to dry a large part of their winter supply of fruits and vegetables at a small cost and without burning any additional fuel.

It was found that in each of the trays about twenty-two pounds of vegetables could be dried at one time and that the drying required from four to six hours. The hot air, after circulating through the stacks of trays containing the fruit and vegetables to be dried, was allowed to escape to the inclosure outside.



Alternators must be cooled with a stream of air. Why not utilize the air so heated?

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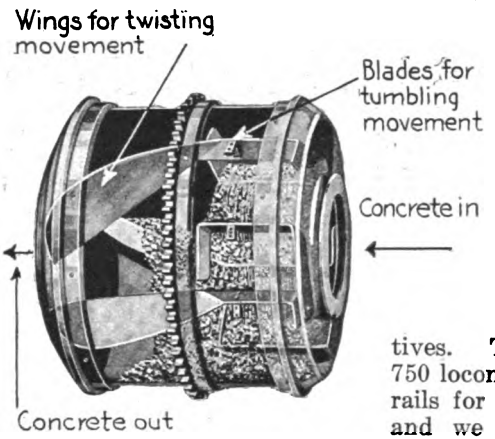
Mixing a Batch of Concrete in Twenty Seconds

A TWISTING or turning movement as well as one of tumbling is required to mix concrete thoroughly in a cylindrical drum. At first slanting blades or fins were mounted inside of the drum, but these did not mix the concrete properly into a homogeneous mass unless the drum was revolved long.

Since time is an important element in mixing concrete and one directly affecting the cost, the new principle of mixing shown in the accompanying illustration was devised.

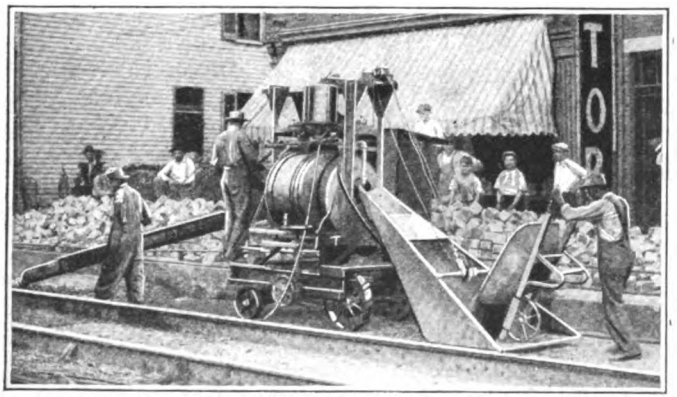
A batch of slush concrete can now be mixed in four revolutions of the drum; and a thicker mixture in from twenty to thirty seconds.

These results are obtained by using two independent sets of blades, a set of six buckets parallel with the length of the drum, and curved wings running from each alternate bucket to the outlet end of the drum. The buckets give the necessary tumbling movement and the wings furnish the twisting or kneading action.



This shows how the twisting and tumbling movements are combined

The use of this mixer will result in a big saving of time, which means a big saving of money.


A mechanical concrete mixer which produces the desired consistency in the course of twenty to thirty seconds

For an Army of Four Million a Ship Must Sail Every Hour

"OUR ship program is a very serious one," says Major W. A. Garrett in an article published by the Journal of the Engineers' Club of Philadelphia; "in fact, the situation during the war. To feed an army of a half million men and the horses for a half million men and the guns for a half million men requires three ships a day—one every eight hours. For a million men, a ship every four hours. For four million men—and we will have four million fighters in France before we are through—one ship every hour from the United States to France, and every ship must run the blockade to get there. A trail of smoke between the United States and France. First we must get our army over, and this will require ships, and then we must send supplies to feed them. Then we must have more ships to take our locomotives. The British have 750 locomotives on French rails for a fifty-mile haul, and we have a 400-mile haul.

Then we must have ships to handle our freight cars (the British have 49,500 for a fifty-mile haul and we have a 400-mile haul). Then we must have ships for our rails, our machinery, and then we must have ships for the foodstuffs and ammunition for our allies."

The Government realized the gravity of the problem at the outset. The taking over of shipyards, the establishment of new ones, and the appointment of Charles Schwab to take charge of ship production are successfully solving the problem.

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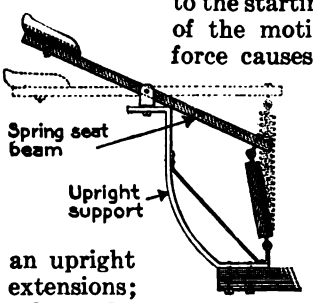
The helical spring absorbs shocks encountered in the rough work of the field and saves bumping

A Novel Spring Seat for Farmers

LEWIS E. BAKER, of Hudson, Illinois, has patented a novel spring seat. The device consists of an upright support provided with lateral extensions; the lower extension is fastened to the vehicle, the upper one carries the seat on a cross-bar mounted on a pivot. The free end is connected with a coiled spring fastened to the bottom foundation. When the driver seats himself the spring is stretched just enough to place the beam in even balance, yet retaining enough "play" to overcome the "thank - you - marms."

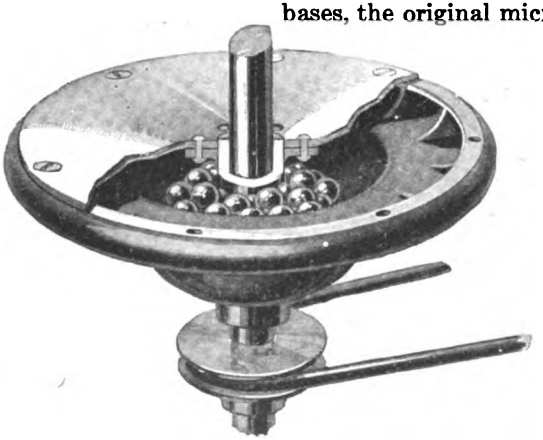


Using Steel Balls in a Flywheel

THE effectiveness of a flywheel in maintaining the rotary movement of an engine at a uniform speed under variations of the load or driving power depends upon the size and weight of the wheel. The heavier the wheel the more effective it will be in maintaining a uniform speed.

But, the heavier the flywheel, the greater the resistance which its inertia offers to the starting of the engine. To overcome this drawback Ralph Humphries, a Canadian, has invented the flywheel shown in the accompanying illustration.

This flywheel, which must necessarily rotate in a horizontal plane, consists of a sheet metal cup with a central depression in the part nearest to the shaft. The weight element of the wheel consists of heavy metal balls or some heavy liquid, such as mercury. When the wheel is at rest the balls or the liquid occupy the lowest part of the cuplike casing. They offer but little resistance to the starting of the engine. As the speed of the motion increases, the centrifugal force causes the balls or liquid to leave the part near the shaft and to move toward the periphery of the wheel. The weight thus equally distributed along the periphery makes the wheel an effective flywheel. As the speed diminishes and eventually ceases, the balls roll, or the liquid runs back to the cup-shaped part around the shaft.



As the speed of the flywheel increases, the balls are whirled up toward the periphery. Thus, the flywheel accommodates itself to the engine load

The Microphone Has Given Place to Other Devices

WHEN the Germans began to mount their motors on sound-absorbing bases, the original microphones employed by the Allies for the detection of the submarine, which depended upon the hum of the engines and motors, were no longer effective. The devices substituted have reached a high state of excellence, not only detecting the presence of the submersible when it is in motion, but also its exact location.

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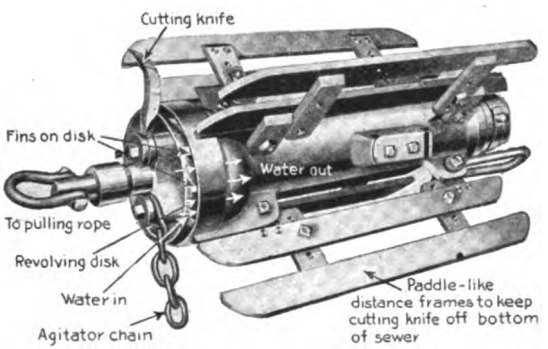
The Sewer-Worm Cuts Its Way Through Clogged Pipes

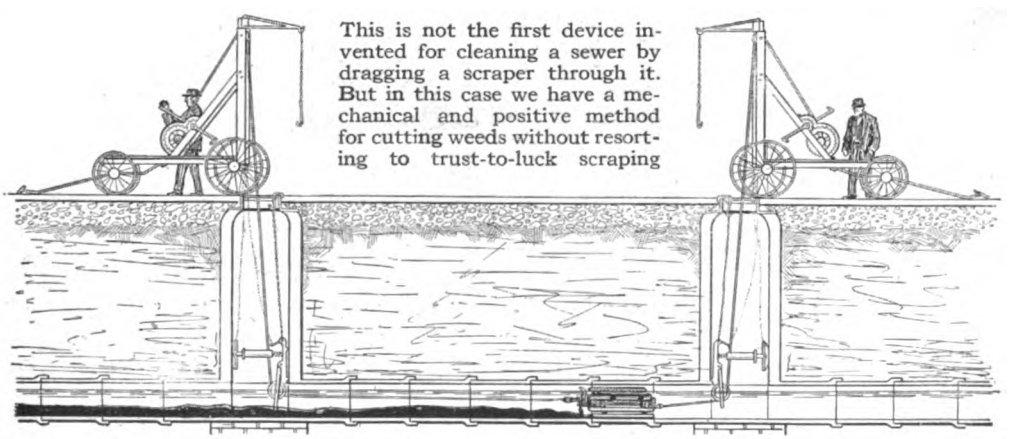
AN entirely new type of a sewer-cleaning device has recently been placed on the market. It consists of a bell-mouthed tube with a rotary disk at the front end. As the tube is drawn through the sewer by means of a rope attached to the hook at the front end of the device, the force of the water, acting upon the slanting fins of the disk, causes it to revolve rapidly within the bell-shaped end of the tube. At opposite points of the disk a curved cutting knife and a short end of heavy chain are attached. As the disk rotates under the pressure of the water against the fins, the chain agitates the clogging deposits on the bottom of the sewer in order that the knife may cut through it easily. Four paddle-like fins attached to the outside of the tube keep the cutting edge of the disk clear of the sewer bricks. The hook, to which the pulling rope or cable is attached, is swiveled and hence does not rotate with the disk. This precludes all danger that the hauling rope will be twisted. The accompanying illustration shows how the device is operated.



As the disk rotates under the pressure of the water against the fins, the chain agitates the clogging deposits for the knife to cut through

Send Your War Inventions to Inventions Section, General Staff

AN Inventions Section has been created as an agency within the General Staff to investigate promptly and thoroughly all inventions submitted to it. Any person desiring to submit an invention for consideration, test, sale, or development, should do so by letter, giving in order the following information: Name and object of the invention; any claim for superiority or novelty; any results obtained by actual experiment; whether the invention is patented; whether remuneration is expected; whether the invention has been before any other agency; whether the writer is owner or agent; the number of enclosures with the letter. A written description and sketches or drawings of sufficient detail to afford a full understanding of the cases should also be submitted. Should the invention be an explosive or other chemical combination, the ingredients and processes of mixture should be stated. All expenses must be borne by the writer. Communications should be addressed: Inventions Section, General Staff, Army War College, Washington, D. C.



This is not the first device invented for cleaning a sewer by dragging a scraper through it. But in this case we have a mechanical and positive method for cutting weeds without resorting to trust-to-luck scraping

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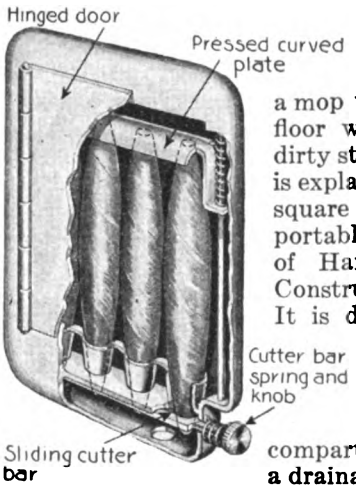
Just One Twist—and All the Cigars in Your Case Are Beheaded

FOR the convenience of cigar smokers, Charles E. Johnson, of New York, has invented a combined pocket cigar-case and cutter. The case, which holds four cigars of average size, has a hinged door and at the lower end four conical, thimble-like cups, intended to accommodate the points of the cigars. These cups are open at the lower end, so that the tips of the cigars protrude into the space below the receptacle for the cigars. A sliding cutter is arranged in that space so that it will cut off the points of all cigars in the case at the same time, when a knurled knob is turned or pushed in. The cut-off ends drop through openings provided in the bottom part of the compartment containing the cutter.



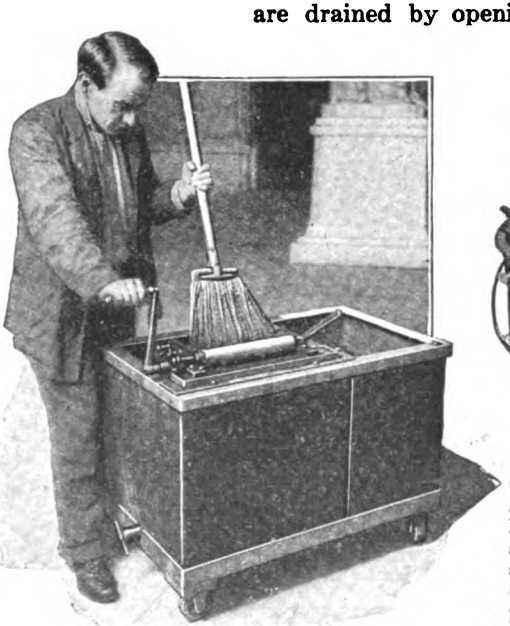
Turn the knob and cut all cigar tips at one clip

The inventor seems to assume that the cigars placed in the case are of the same size; for, to hold them in place and to press them against the cutter, he has provided a curved plate sliding along guide rods and pressed against the lighting ends of the cigars by means of springs. The plate has to be raised before the cigars can be placed into their respective cups. It is not quite clear why the inventor has provided for cutting off the ends of all cigars in the case at the same time instead of arranging it so that each cigar can be guillotined just before it is lighted.

To the smoker who has many cigars to give away this cutter is likely to be very useful.

A Sanitary Method of Cleaning Floors with a Mop

IF you chanced to be in the American Museum of Natural History some time when the floors were being washed, you would see a squad of men, each equipped with a mop which cleaned the white floor without leaving a single dirty streak. This phenomenon is explained by the presence of a square steel tank mounted on a portable truck, the invention of Harry F. Beers, Chief of Construction of the Museum. It is divided into two compartments. One contains the cleaning fluid and the other the clean rinsing water. Each compartment is provided with a drainage cock. A mop-wringer is mounted over the compartment containing the rinsing water. The mop is inserted without the necessity of handling it; the lever is reversed; by turning the crank the mop is drawn upwards and squeezed thoroughly dry. When the job is done, both compartments of the tank are drained by opening the cocks.



Cleaning a floor in the American Museum of Natural History, with a sanitary device consisting of a steel tank divided into two compartments and a mop-wringer which squeezes water out of the mops

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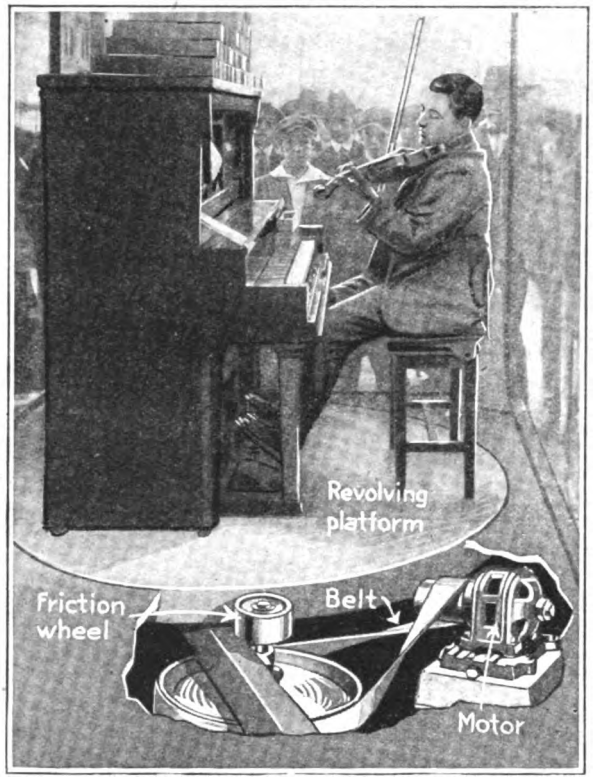
In Retouching Photographs, Move the Plate

TO lighten the most tedious and wearisome task of the photographer, that of retouching negatives, as well as to make the work quicker and more accurate, is the object of an electrical negative retoucher invented by R. L. Woods. This device reverses the ordinary method of retouching by keeping the retouching pencil stationary and moving the negative to obtain the desired effects.

The negative is laid on a flat bed provided with an opening. Through the opening and through the negative shines the light reflected from an inclined mirror below. The mechanical portion of the retoucher, mounted above the bed, consists essentially of a retouching pencil which is worked up and down by a cross arm actuated by two electro - magnets. These magnets are controlled by a vibrating switch set in the circuit so that they are alternately energized, thus raising and lowering the retouching pencil, causing it to mark the negative on the down stroke. The length of the stroke and hence the size of the mark made upon the negative may be regulated by a set screw acting against the cross arm and allowing it to move only the desired distance. The lead is set loosely in the retouching pencil so as not to injure the negative. The operator proceeds easily to get the desired effects of retouching by moving the negative under the pencil.

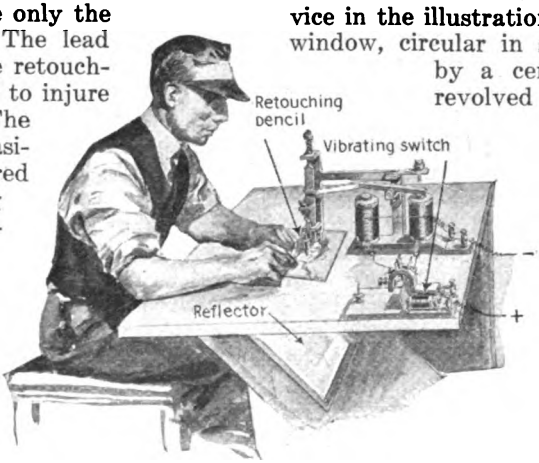
Mr. Wood has hit on a most novel and unique method of photograph-retouching, which will appeal to photographers everywhere.



To make people look at his store window, one shopkeeper installed a revolving platform operated by the device shown above and attracts much notice

Plenty of Action Here; the Whole Window Display Turns

A CALIFORNIA shopkeeper makes his show window revolve by the device in the illustration. The floor of the window, circular in shape, is supported by a central shaft, and is revolved by a friction-pulley rubbing against the under side of the platform's rim. An electric motor beneath the platform supplies necessary power by means of a belt and another pulley on the friction-pulley shaft. The merchant varies his display from week to week.



Did you ever try to draw a picture by moving the paper against the pencil?

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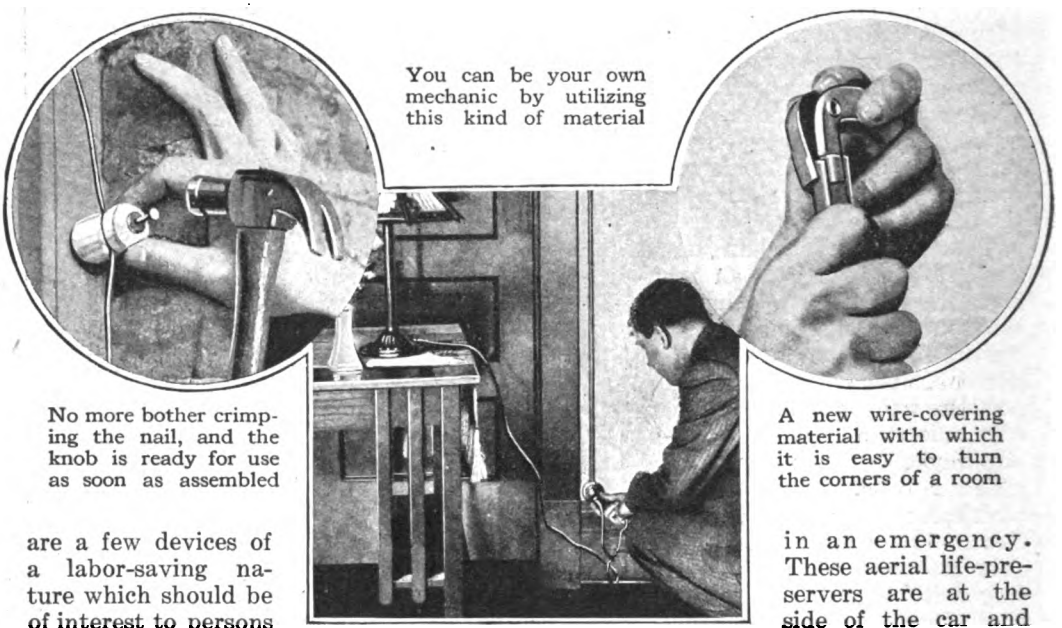
Devices That Make Temporary Wiring Easy

THE present war conditions, especially the shortage of labor and materials, have opened a field for labor-saving inventions in every branch of work. Here are a few devices of a labor-saving nature which should be of interest to persons engaged in temporary electrical wiring. A simple and helpful device is an assembled porcelain knob held in place by a nail with a leather cushioned head. Simply driving the nail into the support fastens it securely. A steel washer serves to hold the parts of the knob together until the nail is driven in. The leather cushion on the head of the nail is intended to prevent the cracking of the porcelain knob when it is nailed down.

For securely covering the wires in accordance with the requirements of the underwriters and without defacing the walls of the room or hall a new covering material has been placed in the market. It is unobtrusive in appearance and easily nailed down by even an inexperienced person. One of the pictures shows the device used for covering the wires where a corner has to be turned. It fits the end of the covering strip and is fastened by a nail driven through a hole provided for that purpose. The strips may be purchased ready for use.



No more bother crimping the nail, and the knob is ready for use as soon as assembled

You can be your own mechanic by utilizing this kind of material

A new wire-covering material with which it is easy to turn the corners of a room

"Shooting the Parachutes" Makes You Feel Like a Wriggling Worm

THE kite balloons which do sentinel duty over the waters surrounding the British Isles are provided with parachutes, which are used by the observers in an emergency. These aerial life-preservers are at the side of the car and may be quickly attached to the braces worn by the men.

No time should be lost in putting the parachute to work after a balloon collapses or bursts into flame, for the bigger the drop the safer it is for the parachuter.

An old kite balloon observer thus describes the sensation of dropping through space at the lower end of a parachute: "You see, the parachute doesn't open until you've fallen about three hundred feet. After that three hundred feet you come down at the rate of twelve miles an hour, or a bit less. The last part of the journey is the worst. You feel like a worm wriggling at the end of a fishing line. As for the first drop, that takes place so swiftly that you never think of it until afterwards. You shut your eyes, and you feel fearfully cold for an instant, and you can't get your breath, and then you find yourself floating gently toward the water, and you have a horrible longing to clutch on to something with your hands."

Despite all, there must always be a fear lest the parachute fails to open as expected.

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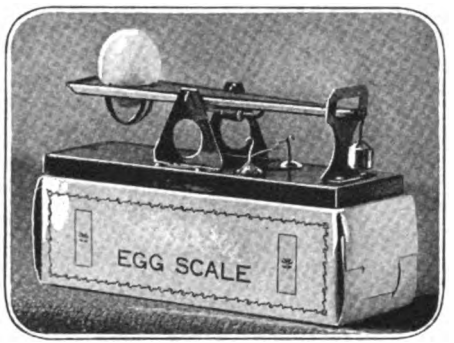
Count Your Chickens Before They Are Hatched by Weighing the Eggs

PRACTICAL tests and experiments by agricultural colleges and poultry raisers have established the fact that it is not profitable for a poultryman to use an egg weighing less than 23 ounces a dozen for hatching, as it was found practically impossible to hatch a strong, sturdy chicken from a lightweight egg. Realizing the importance of the weight of eggs the large poultry breeders in California and elsewhere abandoned the formerly used method of grading by size and employed various crude methods for grading by weight. Recently a practical poultryman, O. C. White, in Gardena, Calif., devised a simple scale which will indicate the weight of eggs weighing between eighteen and twenty-nine ounces a dozen.



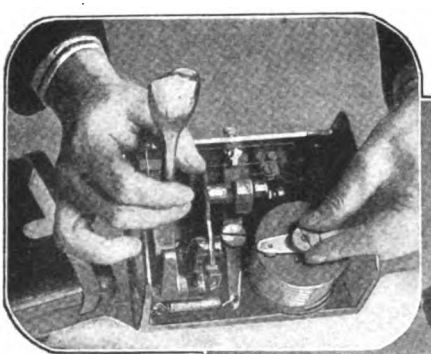
Want to raise sturdy chicks? Weigh your eggs and discard the light-weights

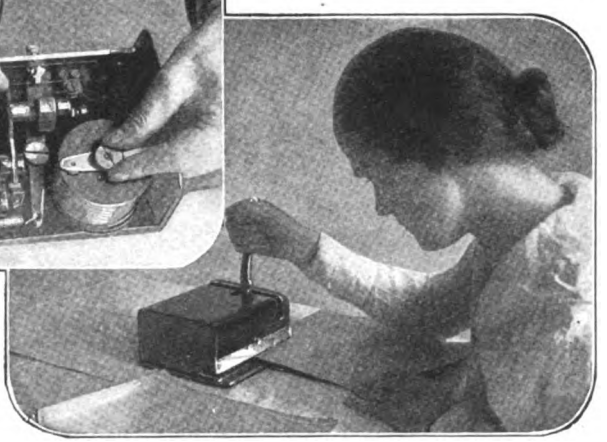
This Stapling Machine Uses a Spool of Wire

A DEPARTURE from the type of machine used heretofore to bind papers together is shown in a new device which, instead of relying upon ready made fasteners, uses a roll of wire and makes its own binders. The economy of operation which results is striking. A single spool of wire serves for some fifteen thousand staples before it is used up, eliminating the loss of time due to frequent reloading, which other machines require. Moreover, the cost of the material is considerably lessened, amounting to less than ten cents for every thousand staples.

The machine binds from two to forty sheets of paper. The new kind of staple, when clinched, is flat and therefore takes up little space in the files. The machine is small, being six inches square on top and bottom and stands four inches high.

Index arrows on the front plate enable the operator to locate the staples accurately with respect to margins and see where the staples will cut the sheet.





Above: Placing the spool of wire in the machine preparing to start off work

The girl can see at a glance just where the binding staples will cut the sheet

Alcohol and Benzole as a National Motor Fuel in France

ALCOHOL, mixed with an equal quantity of benzole, has been used as motor fuel in France. Its use exclusively would have been general had it not been for its steady rise in price. It is the purpose of the French Government to secure a monopoly of alcohol and to encourage its use in industry while laying a heavy tax on its human consumption. It will be carried out when the war ends.

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"All Wool and a Yard Wide"

What "all wool" really means
and why shoddy is a necessity

By Frank Parker Stockbridge

He is wearing all the wool that's in your "all-wool" suit

"WHAT is shoddy?"

Ask that question of the next ten men you meet, and nine of them will reply, in substance if not in terms: "Stuff they use to make soldiers' uniforms of." Some of them will proceed to a denunciation of the President, the Secretary of War, the Quartermaster General and the "Woolen Trust." The tenth man, however, will know something about the wool business, and if he has time and you are sufficiently interested to listen, he will tell you a good many things that tend to make the loud outcries of those who are declaiming against "shoddy" uniforms sound as blatant as the voices of the sheep whose product they think they are defending.

"Shoddy," this tenth man will tell you, "is what you get when you buy 'all-wool' clothes—that is, unless you pay $100 or more for a suit or overcoat. A good, heavy overcoat, now, made of pure, new wool, would be worth somewhere around $200, I should say, perhaps a little cheaper, if you could get it at all—which you can't."

After you have recovered your breath, the man who knows all about the woolen business will tell you more in a minute about shoddy and wool than you could find in the libraries in a week. For instance:

There isn't wool enough in the world—new wool—to clothe the human race properly. If it wasn't for shoddy we would all be wearing cotton principally, even in the dead of winter. We wear a good deal of cotton now, for a large percentage of the popular hard-finished worsted fabrics of which men's clothing is made contains cotton as well as wool.

Shoddy Is Now "Remanufactured Wool"

When your tailor tells you, however, that a piece of goods is all wool, it may contain as high as sixty per cent shoddy, and he will still have told you the truth. For shoddy is wool, pure wool and nothing but wool, but it is wool that has previously been fabricated, perhaps worn, and reclaimed. "Remanufactured wool" is the term the wool trade is now trying to substitute for shoddy, since the latter word has come to have a significance that implies something not only cheap but fraudulent. Originally it was an English factory term, applied to the waste thrown off or "shed" in the process of wool manufacture. Now it means wool recovered either from old clothing or from the trimmings and remnants from the manufacture of clothing and made over like new.

Dye vat and hydro extractor. After material is dyed, rinsed and dried, it is ready to be turned into the picking machines

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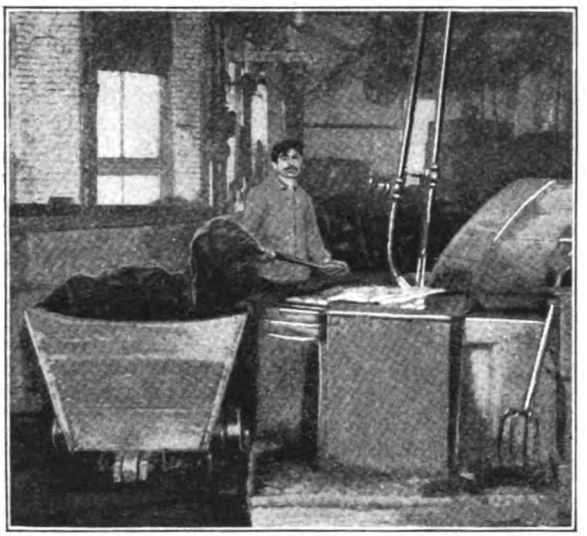
When Uncle Sam dresses his soldiers and sailors in shoddy, the woolen man will tell you, he is merely doing what every other nation engaged in the war is doing. For although there is on hand and in sight in the United States to-day twice as much wool—some 1,260,000,000 pounds—as we have ever used in any one year, there isn't enough to supply the cloth we are making here for uniforms for our European Allies, the goods needed for our own forces and the demands of the civil population, unless there is added to the fabrics made for all of these purposes a good deal of shoddy as well as a lot of cotton. The Committee on Wool Conservation of the National Association of Wool Manufacturers in a statement issued last fall said:

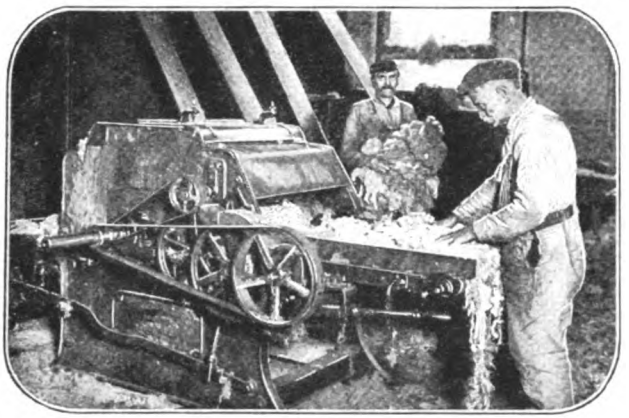


Washing machine in operation. It is in this way that the stock is washed and rendered sanitary

"There has always been a considerable quantity of cotton yarn, raw cotton and reworked wool used in the manufacture of woolen and worsted fabrics and because of the rapid advance in the cost of wool during the last year and a half the percentage of these substitutes has very largely increased and will automatically continue to increase." The association adopted resolutions to discourage the use of all-wool materials by civilians as far as possible and agreed to place on the market as large a proportion of mixed goods as possible.

The Wool Used for Soldiers and Sailors

Cloths used for uniforms by the American Army run from sixteen ounces to twenty ounces to the yard of goods. The sixteen-ounce material, which is lighter weight than is used by any of our Allies, is all new wool. Specifications recently issued for the manufacture of twenty-ounce material for the Government call for fifty per cent wool and fifty per cent shoddy, and the proportion is permitted to run up as high as sixty per cent of shoddy. Overcoat materials, weighing thirty-six ounces and more to the yard may be even higher in the shoddy percentage, as are Army blankets.



This picture shows the picking machine in operation. It tears and converts the stock into threads again

"At that," your friend in the wool trade will tell you, "our soldiers are better clothed than you are, for you are wearing worsteds, and while worsteds don't contain shoddy, they do contain cotton. Out of 3,000 worsted looms in the United States, there were in September, 1915, only 950, or 31.7 per cent, running on cotton warp goods. In September, 1917, 2,395 of these looms, or 77.2 per cent were making cotton warp fabrics."

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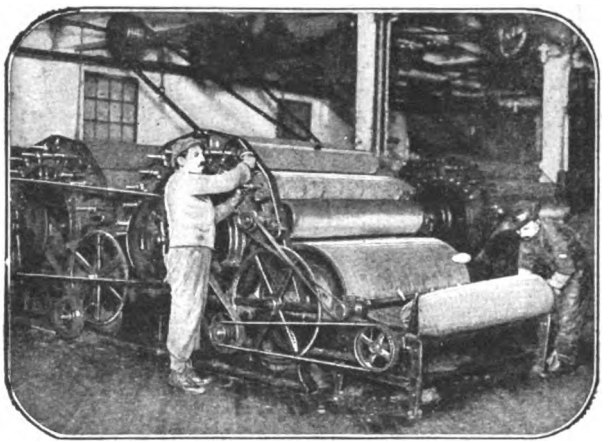
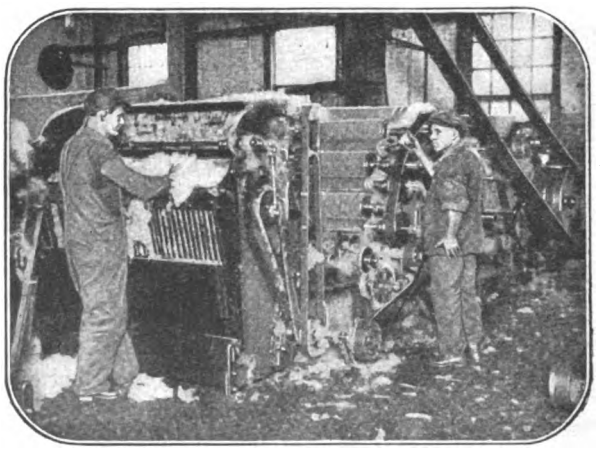
You ask the difference between woolens and worsteds, and learn that it is in the spinning of the threads from which the fabrics are woven. The characteristic of wool that makes it different from all other fibers is that it tends to "felt" or mat together, the fabrics being covered with surface spines or irregularities that interlock with those of adjoining fibers to form a tight mass without weaving. Woolen goods are made of carded wool—that is, wool that has been merely smoothed out, as it were, and drawn down into threads with the fibers tangled, twisted and running "every-which-way." Fabrics woven from these threads require a vast amount of "finishing," the purpose of which is to mat or "felt" the fibers of the finished cloth together, producing smooth surfaces and a "body" that depends as much upon the felting quality of the wool for its substance as it does on the weaving. Worsteds, on the other hand, are woven from threads formed just as cotton threads are—the wool combed out until the fibers lie parallel, when they are twisted into hard threads. Worsted cloths require very little finishing after weaving. It is smooth to the touch.



The carding machine breaks up the stock into its fibrous state and prepares it for the spinner



This is the way in which the stock comes out of the carding machine—broken up into fine fibers

Have You Heard of "Mungo" or of "Extract?"

"New wool fibers," your friend tells you, "run from five or six inches to above fifteen inches in length and from 1/3,000 of an inch to 1/275 of an inch in diameter, depending upon the breed of the sheep, its age when shorn, the country where it was bred and the particular part of the sheep from which the wool came, as a single fleece will contain several grades. Shoddy naturally varies in quality as much as do the cloths made from these different grades of wool. Indeed, the term 'shoddy' is technically applied only to wool recovered from cloth made from the finest grades and longest fibers. Reworked wool from cloths of lower grade is termed 'mungo' and that from cloth containing cotton as well as wool is called 'extract,' because the cotton has to be extracted from the wool by dissolving it away in sulphuric acid. And since the fiber of any of these grades of shoddy is short, compared with new wool, a considerable percentage of new wool must be mixed with it to make it usable. For the same reason, it cannot be spun into the sort of threads required for worsteds, but must be used in fabrics

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the finish of which depends upon felting."

How heavy the demand of an army for woolen clothes is may be estimated by the fact that the average life of a uniform in the front line trenches of the British Army is only about six weeks. Early in the war, discarded uniforms were burned or destroyed. Now they are taken back to England where they are sorted, cleaned and repaired, if savable, and if not, sold for reworking as shoddy. About ninety truckloads of uniforms a day are received at the plant, which is saving the British Government about $5,000,000 a year. Worn-out uniform trousers bring $420 a ton; jackets, which originally contained a larger proportion of shoddy, $320 a ton. British uniforms are now being made of a cloth having an all-wool worsted warp and a wool filling which contains a high percentage of re-worked wool, or shoddy.

Millions of discarded uniforms are now being sent back to England to be remanufactured into shoddy cloth

The foremost American wool expert recently estimated that, to equip the two million men already provided for in our Army and Navy with their original outfits of uniforms, overcoats and blankets, it would require two hundred and forty million pounds of wool, or nearly the entire production of the United States for the year. If these require replacing on an average only twice a year, it is obvious that some of us will have to wear more shoddy—and more cotton—than we have been accustomed to.

In Germany and France and, to some extent in Great Britain, the shortage of wool was felt early in the war and the respective governments made appeals to their peoples to contribute every scrap of cast-off woolen material which could be used to "stretch" the supply of new wool.

New Rails from Old—How Railroads Save Money

STEEL is scarce and rail-rolling plants must charge more for their product than ever before. That is why George Langford, of Milwaukee, has patented a process for making new steel rails out of worn, old ones.

Several railroads are using his process; for they find they can reroll a 100-lb. 33-ft. rail into a 90-lb. section 34 feet in length or to a 92-lb. section 33 feet long. If the worn rails were cropped for relaying, their length would be only 30 feet. The new rerolling process increases the length as well as reshapes the heads.

The method of making old rails into new calls for heating the worn rails and passing them through reshaping rolls. In order to avoid changes in the character of the steel the work must be done at a moderate temperature. This means that the metal which must be forced to fill the section in the rolls while at a low temperature, is subjected to a severe draft that may cause internal difficulties and make the rails unreliable.

No special preparation of the rails for rerolling is necessary except running them through a grinding machine which removes the fins and barbs which have resulted from the pounding of the wheels.

This trouble has been overcome by bringing only the gage side of the rail head to standard section in the rerolling process, while the other, or outer side, is permitted to be of smaller size. This compensates for the loss of metal by wear.

Some railroads that have adopted the Langford process find the old 85-lb. rails roll into new 75-lb. rails, the 90-lb. ones into 80-lb. and the 100-lb. into 90-lb. rails.

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Behold the University-Bred Horse Dentist

Doctoring the teeth of domesticated animals is a real business necessity

By J. G. Dolan, D. V. S., D. D. S.

Instructor in Dentistry and Veterinary Physiology in the New York State Veterinary College of New York University

THANKS to the fact that their food is raw and unrefined and contains all the mineral matter so necessary for the growth and repair of the tissues of the teeth, domesticated animals are almost immune from natural decay as well as diseases of the teeth. Yet, injuries, infection and unhygienic feeding often cause domesticated animals to experience acute tooth-troubles and for business reasons as well as from humanitarian considerations it has been deemed good policy to make animal dentistry part of the curriculum of our veterinary schools and colleges.

Veterinary students at New York University studying the microscopic structure of the teeth of domestic animals to learn of their diseases

At the New York State Veterinary College, which is part of New York University, animal dentistry is taught to students by lectures and practical demonstrations. The studies include oral surgery, examination, treatment and extraction of the teeth and determination of the age of animals by the character and condition of their teeth. The determination of the age of domesticated animals is of considerable economic importance, as the age to a great extent determines the value of an animal. The properly trained veterinarian is able to render expert assistance to prospective buyers of stock and is often consulted for that purpose.

The technique of animal dentistry is much like that of human dentistry. An impression of the animal's teeth is made in a modeling mass composed of French chalk and beef suet or bees' wax. The compound is heated until soft and is pressed tightly against the teeth and gums. It hardens rapidly and may be removed after about sixty seconds. The mold thus obtained is then filled with plaster-of-paris. After the plaster has become hard, the mold is softened again and removed. The casts obtained by this method are used by the students in their studies and experiments. One of the illustrations shows the photograph of a finished cast of the lower incisor

He hates dentists as much as you do. The two students are trying to get an impression of his teeth in a modeling mass

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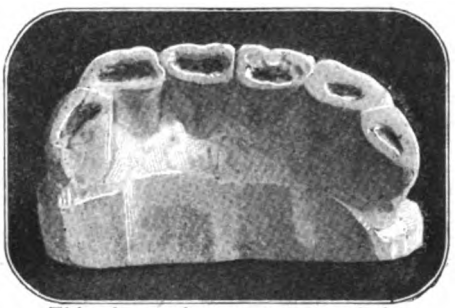
arch of a horse, made of plaster.

The anatomy of the teeth is studied from microscopic slides and, when necessary, X-ray examinations of the diseased jaws and teeth of animals are made. The students are also instructed in oral surgery, which includes the treatment of fractures, the removal of benign or malignant tumors, the removal of foreign bodies and the treatment of wounds in the mouths of animals. The extraction of broken down carious or fractured teeth is performed under general anaesthesia, as are all surgical operations.

To assist the students in obtaining a thorough knowledge of the development of the teeth of animals and to enable them to judge from the teeth the age of horses, donkeys and cows, a series of casts is provided showing the development of the teeth of horses from one month to thirty years and of cattle to twelve or fifteen years. These casts are also used in court where expert testimony is conflicting.



This shows the appearance of the finished cast which may be used for determining the age of the horse

The mold is filled with plaster-of-paris and a cast is obtained, which can be used for demonstrations and the study of the teeth

How Science Has Convicted Plants of Causing Hay Fever

WIND-POLLINATED plants are responsible for hay fever. Science is able to make this statement after considerable study. Moreover, it is also able to state just what plants are responsible. In the biological laboratory of the American Hay Fever Prevention Association, the oak, pine, willow trees, rag-weeds, marsh elders and cockle-bur have been found to cause direct hay fever. In the grasses, the amaranthus and yellow dock stand accused of causing indirect hay fever.

The evidence against the trees, plants and grasses mentioned above was obtained through the use of a novel apparatus which determines whether a flower is wind-pollinated or not. The apparatus consists of a hollow cylinder with a fan attached at one end, by means of which a current is sent through the tube at from one to fifteen miles an hour. The flowers are held in place in the tube, the fan started, and the pollen is captured on glass slides coated with glycerin held in position at the outer end of the tube. The number of spores to a square inch of slide surface is determined, and, finally, the rate of pollen deposit of each flower.

The common rag-weed showed the highest pollen deposit in a recent test. The giant rag-weed and the marsh elder follow it closely. These weeds, together with the grasses, spread their pollen in enormous quantities. In the case of corn the pollen is so large that it can not be distributed over a wide area. Rag-weed pollen can travel half a mile, while corn pollen goes forty feet. Plants whose pollen is not found in the air and which are thus not directly responsible for hay fever are the goldenrods, daisies, dandelions and sunflowers.

How to avoid hay fever is the next question. Those who are subject to it may try breathing through fine cloth.

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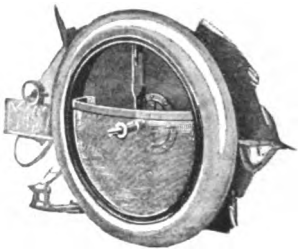
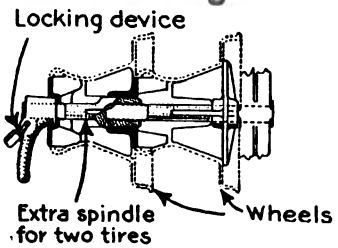


Above, a wheel in place, with rear disk broken away to show wheel and tire cover in position

In middle, above, a close-up view of clamping device of spindle nut, with padlock fastening



Above, wire cage mounted on forward disk to carry spare tools and other accessories to make repairs

At left is shown an auxiliary spindle strapped over the main spindle-bar to carry second tire or wheel

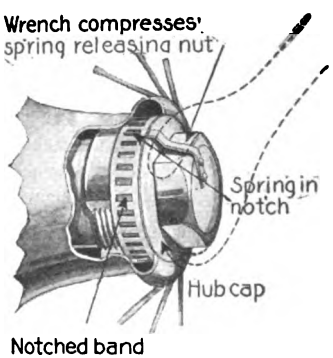
A Neat Thief-Proof Carrier for Automobile Tires

A SIMPLE and neat automobile tire-carrier is shown in the illustrations above. It consists of a pair of convex metal disks between which the tire or wheel is clamped by means of a nut on a supporting spindle attached to the rear of the car. Removal of the spindle nut instantly releases the outer disk and the wheel with its tire or the rim with the tire, according to whether a spare wheel with its tire complete is used or merely a spare tire on a rim.

The spindle nut holding the tire or wheel in place is provided with a clamping device which can be fastened with a padlock. The tire may also be enclosed in a cover between the two disks so that it is protected from rotting due to rain, snow or dirt. If desired, two complete wheels and tires or two tires alone may be carried on the spindle at the same time by the use of a second auxiliary spindle slipped over the main spindle bar. The forward of the two disks is provided on the inside with a semi-circular wire cage to hold tools, tire patches, etc.

Lock Your Hub-Cap and Your Wheel Won't Come Off

SERIOUS accidents may occur if a wheel of a rapidly moving automobile comes off. Wire wheels are easily removed, and it is important to prevent them from working loose while the car is in motion. A simple device for locking a wheel securely in place on its hub is shown in the accompanying picture. A band with a series of rectangular notches is fitted around the inside of the hub. To the nut of the hub-cap a spring is fastened, the free end of which is slipped between the hub-cap and the hub. When the wrench is forced on the nut it holds down the spring sufficiently to prevent its square head from engaging in one of the notches while the nut is fastened. When the nut is screwed down and the wrench is removed, the spring, no longer held down, presses against the notched band of the hub and its square head springs into one of the notches, locking the nut securely. The advantage of this device is that it requires no key or special tools to fasten or unfasten it. The ordinary wrench will operate it.



Forcing the wrench over the nut releases the hold of the locking spring

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Using One Pane in a French Window for a Ventilator

ALTHOUGH they are steadily becoming more popular, it has always been found rather difficult to regulate the ventilation of a room having French windows because of the fact that any opening must necessarily extend from top to bottom, which causes drafts.

An excellent way of avoiding this difficulty is to remove the pane of glass from one of the upper corners. Take four strips of new tin about 1 in. wide and bend them double so that they will fit around the edges of the glass like passe-partout tape. Solder the corners, and then solder on two narrow butt hinges. Fasten a small projecting lug to the outer edge, paint to match the woodwork, and hinge in place. Run a light cord from the projecting lug through a small eyelet directly opposite in the sash, and then down to one or more small hooks. Tie a ring to the lower end, and make the length such that the glass will be swung into place and held there when the ring is on the lower hook. By means of a small spring run from the glass frame to the sash near the hinges, the ventilator may be made to swing open as soon as the cord is unhooked. Where the appearance is not important, a piece of wall board may be used instead of glass, proceeding in the same manner as above indicated.—JOHN D. ADAMS.

One pane of glass is used for the ventilator opening

How to Put a New Wick in a Mechanic's Torch

TORCHES are used by all classes of mechanics. The ordinary torch has a wick about ¾ in. in diameter, consisting of strands of candle wicking, and when a new wick is to be inserted it is often found to be a troublesome job. The easiest way of re-wicking a torch of this kind is to pass a strand of the candle wicking through the oil opening at the top, and then through the extending wick tube of the torch; then tie the end of this strand to the main strand so as to form a loop about 3 feet long. By pulling this loop through the torch a strand is added at every complete cycle. After repeating this until the wick tube of the torch is completely filled with wicking, it is cut off ½ in. from the top of the tube, the rest of the loop being inserted into the oil hole of the torch. Candle wicking may be purchased in rolls or balls from some hardware stores or plumbing supply houses or, possibly, ship-chandler stores. —W. H. THOMAS.

A Solution for Re-Inking Typewriter Ribbons

USE the following formula for black: 1 oz. of aniline black, 15 oz. of pure grain alcohol, 15 oz. of concentrated glycerine. Dissolve the aniline black in the alcohol, then add the glycerine. For blue ribbons use Prussian blue; for red ribbons use red lead in place of the aniline black.

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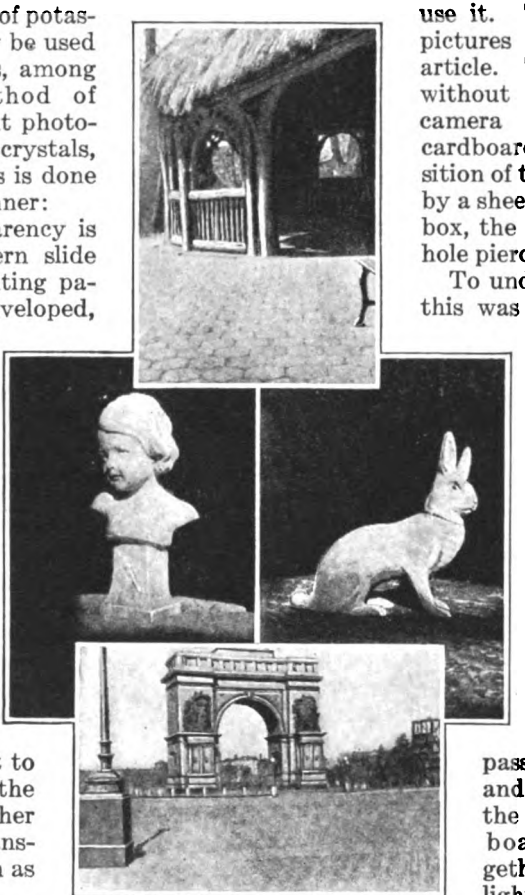
Removing Photographic Film for Mounting on Watch Crystals

IT is not generally known that the film may be easily removed from a negative plate by soaking it for a few minutes in a solution of carbonate of potassium. This fact may be used in a number of ways, among which is the method of mounting transparent photographs on watch crystals, chinaware, etc. This is done in the following manner:

A positive transparency is made, using a lantern slide plate instead of printing paper; this plate is developed, fixed and washed in the usual way and then soaked for about five minutes in,

Carbonate of potassium..... 6½ oz.
Water..... 6 oz.

After this is done it is wiped dry with a soft cloth and put by over night. In the morning it will be found that the film lies loose on the glass. It is then cut to size and pasted on to the watch crystal or other article with any transparent adhesive, such as Canada balsam.



Reproductions from films that are made with a pinhole camera lens

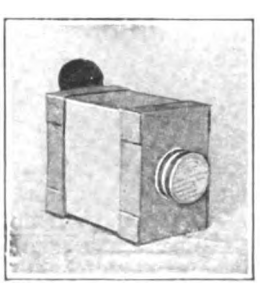
Color Tracing to Keep Ink from Running

IT is always best to color tracings on the back, as the ink lines are liable to run or be obliterated when the color is applied. The colors should be mixed dark enough, so that they may appear in the proper depth on the other side. If the ink or color does not run freely on the tracing cloth, it may be made to do so readily if mixed with a little oxgall.

A Homemade Camera to Make Pictures Without a Lens

THE next time your snap-shots turn out to be failures do not place all the blame on the lens. It depends how you use it. Take a look at the pictures accompanying this article. They were all made without any lens, and in a camera made of common cardboard. The ordinary position of the lens was occupied by a sheet of tinfoil and a pill-box, the tinfoil having a tiny hole pierced with a needle.

To understand clearly how this was accomplished, make the experiment illustrated. If the room is darkened except for the one light, an inverted image of the lamp filament will appear on the second sheet of cardboard, incidentally proving that light travels in straight lines. From each point on the lamp filament, a light ray passes through the hole, and registers itself on the dark sheet of cardboard. Joining together, these points of light make up the image, its size depending on the distance from the light source, which may be an open gas flame as well as an in candescent lamp.



This lenseless camera can take good pictures

The camera used was built around a film-pack, 2¼ by 3¼ in. in size. The flat films are most adaptable to this makeshift camera and the size is economical. The pinhole should be about 5 in. from the film surface for the best proportions. With a hole less than 1/100 in. in diameter, the exposure for an outdoor picture will be about one minute in

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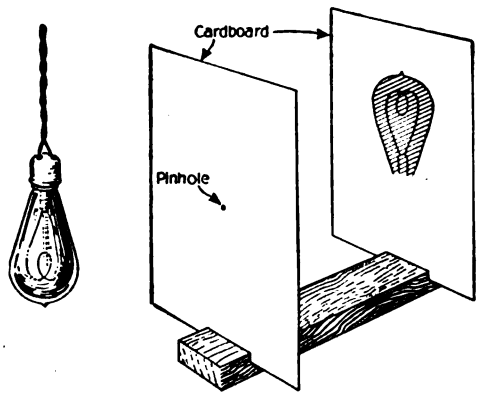
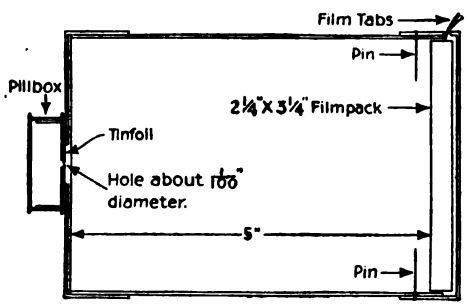
bright sunshine. The pictures of the toy rabbit and the bust were made indoors, with an exposure of 3 minutes in the sunlight, through a window.



An illustration showing how light passes through a pinhole and inverts the picture

A sectional view of the box is shown in Fig. 2. All fastenings can be made with glue except the back cover, holding the film-pack. To keep the film firmly in place, four common pins will work well, care being taken to pass them into the box at the corners in such fashion that they will not enter the pack or lie in front of the film. Care should be taken in punching the hole to make a clean cut opening with a very fine needle. Outdoor views are easy to make, ordinary traffic having no effect on the film. The camera, of course, must be set on some



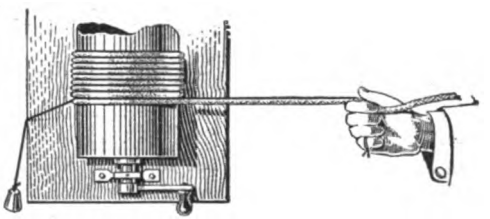
A sectional view of the pastboard box with pierced tinfoil and pill box attached

stationary object, and kept from moving. The length of the exposure necessary to allow light rays to register a picture on the film will not result in having moving objects shown in the finished picture.—JOHN F. MAHONEY.

Spacing the Windings on High Frequency Coils

WIRE for coils on electrical devices may be spaced evenly by the use of a cord run parallel with the wire at the same time. The wire is first attached to the coil and one turn is taken, then the cord or string is tied to the little finger on the right hand and passed over the first finger and across the core. A weight is hung to the opposite end. The cord is laid close to the first coil of wire and the second turn of wire is run on next to the cord, which separates the two turns. The wire is kept close to the cord on the finger just as if winding the wire and the cord on the core parallel and at the same time. As each succeeding turn is wound on, the wire pushes the cord over, thereby spacing the turns evenly.

This method is much better than winding on two turns of wire parallel and



A cord of any size used between the coils of wire for spacing them evenly

then unwinding one of them to make the space. The winding may be done almost as quickly as one can turn the coil. The spacing is regulated by the size of the cord or twine used.—ODIS REYNOLDS.

Raising the Fluid Level in a Gasoline Tank

ONE day during the boating season I found that I had run out of gas, three miles from the nearest gas station. Knowing that the nipple of the gasoline pipe which leads to the carburetor was inserted about ¾ in. up from the bottom of the tank, I paddled towards the shore, where I looked up some clean, irregular pebbles that were small enough to enter the tank. I dropped them in and thereby raised the gasoline enough to allow me to proceed to the nearest gas station to renew my supply.—W. H. THOMAS.

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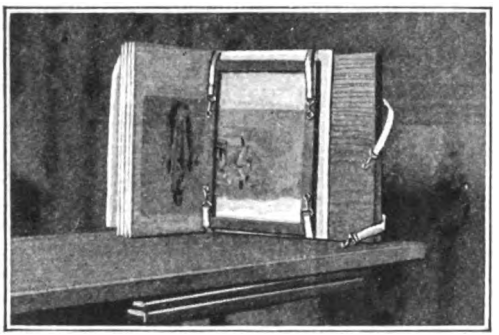
An Easel Clamp to Hold Copy for Photographing

PERHAPS you have tried to copy a picture from a book or magazine and have found considerable trouble in keeping the page flat and in a position for focusing the camera on it properly. Where the page curves, portions of the picture are sure to be out of sharp focus. Often the leaf cannot be removed from the book or magazine and must be clamped in some way, and when the back is rigid, as in the stapled magazines and many books that are not properly made, the problem becomes annoying.

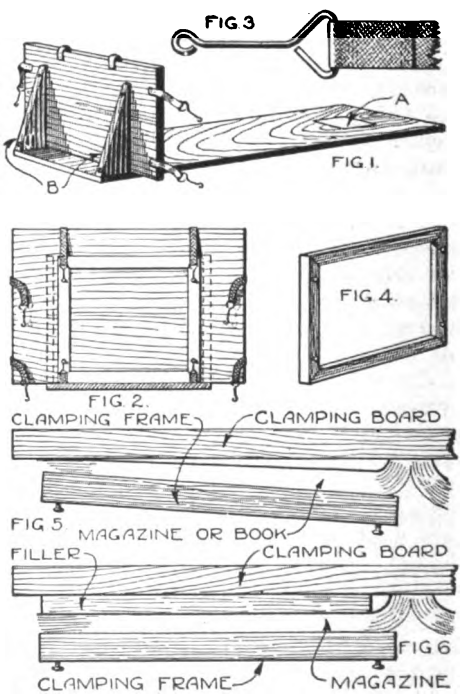


The book page as it is clamped on the easel for making a copy or lantern slide

The device shown in the accompanying illustrations has proved very helpful in making negatives of pictures that may be desired for lantern slides and the like. No attention will be given to the handling of the camera. Its approximate location is shown by the rectangle *A* on the base board in Fig. 1.

A baseboard 3½ or 4 ft. long is the first requisite. This board may be 12 in. or more wide, and while the vertical board is secured at one end and prevents warping, a cleat should be secured fast underneath. A clamping board, to which the book, magazine or loose leaf is secured, may be nailed to the baseboard by driving the nails through it and into the edge of the clamping board. It must be secured in a vertical position so that it will stand at right angles to the surface of the base. Two braces will be needed to keep the clamping board in position. They are shown at B, in Fig. 1. These braces may be long and narrow, but ought to be ¾ in. thick. They must have square corners where they meet the clamping board and base. The braces should be secured with screws.

The manner of clamping the book to the board is shown in Fig. 2. Straps are made of elastic tape with wire loops, Fig. 3, sewed on at the loose ends. The other ends are fastened to the edges of the clamping board with two tacks in each piece of tape. The straps are distributed two at each edge. A rigid frame, Fig. 4, is also necessary. The one shown was made of oak pieces to measure 5 by 7 in. in size from ⅝-in. square stock. Four brass escutcheon pins are driven in part way into the face of the frame, two on each of the 9-in. pieces about 2 in. from the ends. Four other pins may be used, two on each end piece, but this is not necessary. About ⅛ in. of the escutcheon pins are allowed to project above the surface of the wood. The pins may be slanted so that the heads will slant slightly toward each other on each side, which will hold the pull of the elastic a trifle better than if straight. Other sizes of frames may be convenient for smaller or larger pictures.



Details of the parts and their relative location for making the easel clamp

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The wire loop, Fig. 3, is made of about No. 14-gage spring brass wire bent with round nose pliers. The shape is not important.

We will suppose that a picture to be copied is on a left-hand page of the book. The book is placed in a vertical position as shown, with the frame pressed against the page and surrounding the picture. Bring up the two loops from below and hook over the lower side escutcheon pins. Bring down those from the top and hook them similarly. The straps should be short enough to give a strain to the elastic, which in turn gives considerable pressure to the frame against the page of the book.

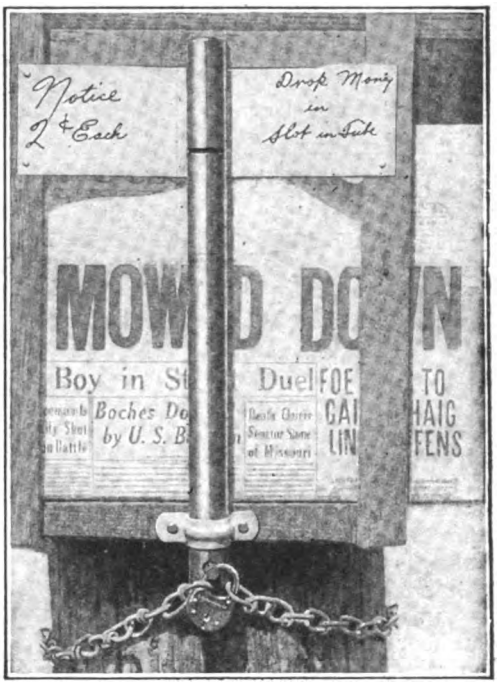
The page will now be ready for exposure. If the book or magazine has a pliable back, so that it will open out flat, the book will not be harmed in the least; but when the back is stiff, as in the case of magazines that are stapled, as in Fig. 5, there will be need of additional backing to bring the pages flat face to the lens. In this illustration the top of the clamping board is seen. The difference between the center of the book and the outside is indicated by *C-D*, the portion that is gripped by the staples or binding. This difference must be compensated for by some kind of backing, such as a board of the right thickness, or perhaps a book can be found that will serve the purpose; something that will bring the pages parallel to the surface of the clamping board as in Fig. 6. This gives a perfect surface equi-distant at all points from the lens of the camera Another magazine may be used in some cases as a filler.

In copying several plates from the same book or magazine, it may be desirable to keep the clamping board in the same relative position to the light. If a picture is to be copied on the opposite page from one that has just been exposed the unclamped pages may cut off the light. In such cases the book may be turned upside down.

When the picture is at right angles to the printed lines, a portion of the book lies on the base of the copying device and the straps from the sides are used instead of those above and below as shown in Fig. 2. The eight straps are provided to meet any contingency that may arise.—C. M. MILLER.

Using a Piece of Gaspipe for a News-Stand Coin Box

A NOVEL coin holder has been devised by a newsboy. He used a pipe about 1 ft. long for holding the



A self-selling news-stand with gaspipe to hold and padlock to safeguard the coins

pennies. The top has been plugged and a nail driven through it. About 2 in. below the top a slot for the pennies has been filed in the pipe. Near the lower end of the pipe a pin passes through it and is locked. To remove the pennies from the pipe, the newsboy unlocks and removes the pin.

Cutting Sheet Iron with a Hack Saw

AFTER breaking four or five hack saw blades while trying to cut a piece of sheet iron in a vise, it was discovered that by holding the saw almost longitudinally to the sheet, instead of at right angles to the flat surface, the vibration of the sheet iron was reduced sufficiently to cut it with ease. The danger of breaking the hack saw blades was also reduced materially.—W. H. THOMAS.

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Making Useful and Ornamental Novelties Out of Gourds

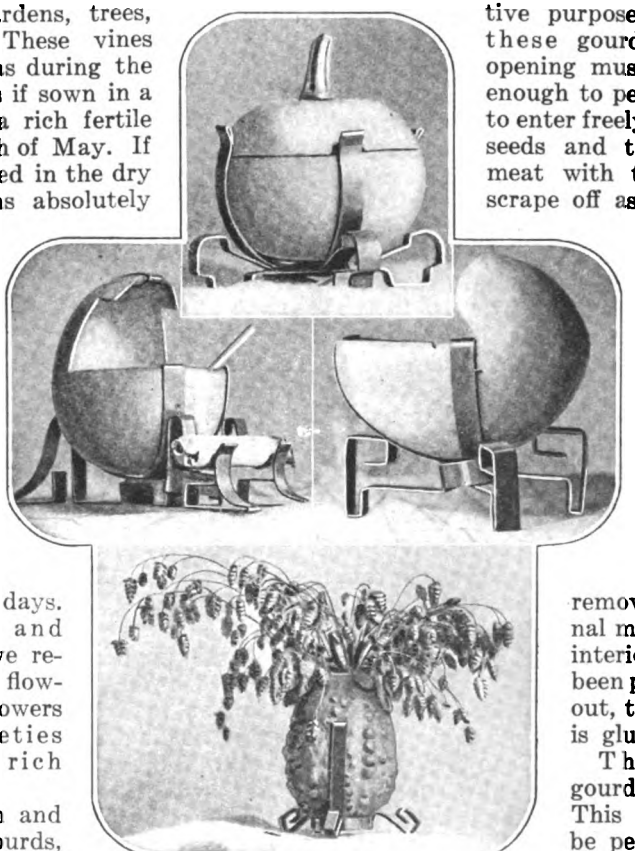
ALL of the many varieties of the peculiar and unique ornamental gourds may be grown in the garden. When looking at the fruit, one instinctively feels the possibilities they present for beautiful ornaments or useful utensils. The gourd, when ripe, has a wood-like vine. The natives of the tropics and sub-tropics make saucers and bowls, basting-ladles and water bottles out of them.

The bloom of the gourd and a small gourd on the vine

We value the gourds for their beautiful quick growing vines, which quickly climb trellises for summer gardens, trees, stumps, etc. These vines cover large areas during the summer months if sown in a sunny spot in a rich fertile soil in the month of May. If kept well watered in the dry summer months absolutely no other care is necessary.

The flowers generally begin to open late in the afternoon and remain open all night until about 9 o'clock in the morning, although they are also open on damp, cloudy and cool days. Bottle gourds and Luffa both have resplendent white flowers, while the flowers of other varieties have a deep, rich yellowish hue.

The profusion and variety of the gourds, which differ as to size, shape and color, may be traced back to degenerate forms. Some of them may resemble apples, pears, eggs, melons, oranges, bottles or clubs. The wart-gourd is especially varied. In color the specimens range from a pure white to a deep orange or from a bright yellow to a dark green. The rind may be smooth, fluted or warted and have two or more colors so arranged as to give a picturesque effect.



Various artistic and useful articles made from the gourd shell and brass or copper strips

The specimens chosen for preserving are, naturally, those most origginal and peculiar. When prepared as it actually appears in its natural form it is used either as an ornament for the sideboard or as a garland for decorative purposes. To prepare these gourds properly, an opening must be made large enough to permit a teaspoon to enter freely. Remove the seeds and the soft spongy meat with the spoon, and scrape off as much as possible of the harder meat. The long slender bottle, and club gourds cannot be hollowed out in this manner, therefore a slender rectangular piece of the fruit is usually cut out to facilitate the removal of the internal meat. When the interior of the shell has been perfectly cleaned out, the cut-out piece is glued in again.

The hollowed gourd is then dried. This operation must be performed slowly. The best place is in some warm room, al-

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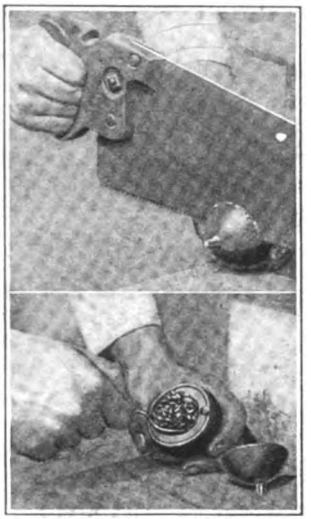
though equal success may be had in the warm autumn sun. Intense heat should be avoided as the gourds are apt to shrivel when dried too quickly. The best way is to secure a box of perfectly dry sand and embed the gourd in it, the gourd itself being tightly packed with sand. The sand which is packed into the gourd should be replaced from time to time with fresh dry sand. Dried in this manner the gourds retain their shape to the best advantage.

The preparation of gourds for utensils and knickknacks is much more simple. Here all those parts which are to be discarded are simply cut or sawed off, the meat removed and the shell dried as described.

The dried gourd can be decorated with carving or by searing designs on it. Miniature paintings are also very effective. A dryer is added to oil paints.



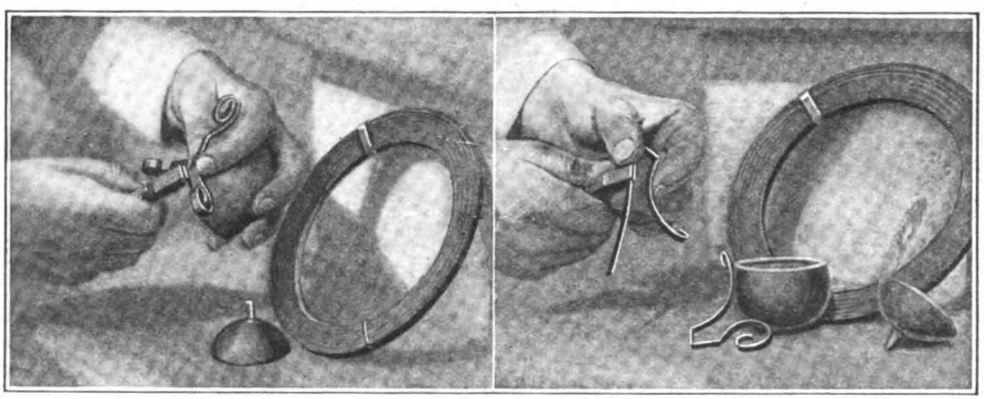
Sawing the gourd and scooping out the pith

Venetian iron work, or bent iron work as it is sometimes called, is very effective when used in conjunction with gourds. Brass, which can be bought by the pound in the larger hardware stores, is sold in flat rolls in all widths and is better adapted for this purpose than iron which is ordinarily used. All that the beginner in this work will need is a pair of flat-nosed pliers and a pair of strong shears. The brass is cut into suitable lengths and bent into scrolls or other ornamental designs. These must first be traced on a piece of paper and then copied. Place the brass over the design frequently to see that it coincides perfectly with the drawing. Last of all, the different pieces are assembled and clipped together wherever necessary to make the network of brass as rigid as possible. Clips are made from strips of brass about ¾ in. in length bent to form the letter U. When placed around a scroll the ends should overlap and the sides fit snugly. The projecting flaps are clinched down tightly when the scroll is in the required position. These clips hold the scrolls firm and steady.

Some gourds, as for instance the club gourds, need no artistic after touches. The lower part of the gourd is sawed off diagonally and the meat removed.

Dry Battery Sealing Compound Used for Wax Imitations

FOR making wax copies of keys or other small designs I have found that the wax on the tops of discarded dry batteries is a very practical and satisfactory substitute when other materials are not at hand. The dry battery wax is prepared by melting it in a cup over a flame or on a stove.



Cutting and bending the metal strips for making the feet or other ornaments to decorate the gourd shell. Strips of brass or copper may be obtained for this purpose from a local hardware store

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Mounting Photographic Prints on Glass

USE 4 oz. gelatin, soaked for a half hour in cold water. Place it in a glass jar, adding 16 oz. of water, and put the jar in a large dish of warm water to dissolve the gelatin. Pour the solution into a shallow tray, then have the prints rolled on a roller, albumen side up, and holding them by the corners, pass them rapidly through the gelatin. Care should be exercised that no air bubbles are permitted to form. Press print firmly on the glass. The better the quality of the glass used, the finer will be the effect produced.

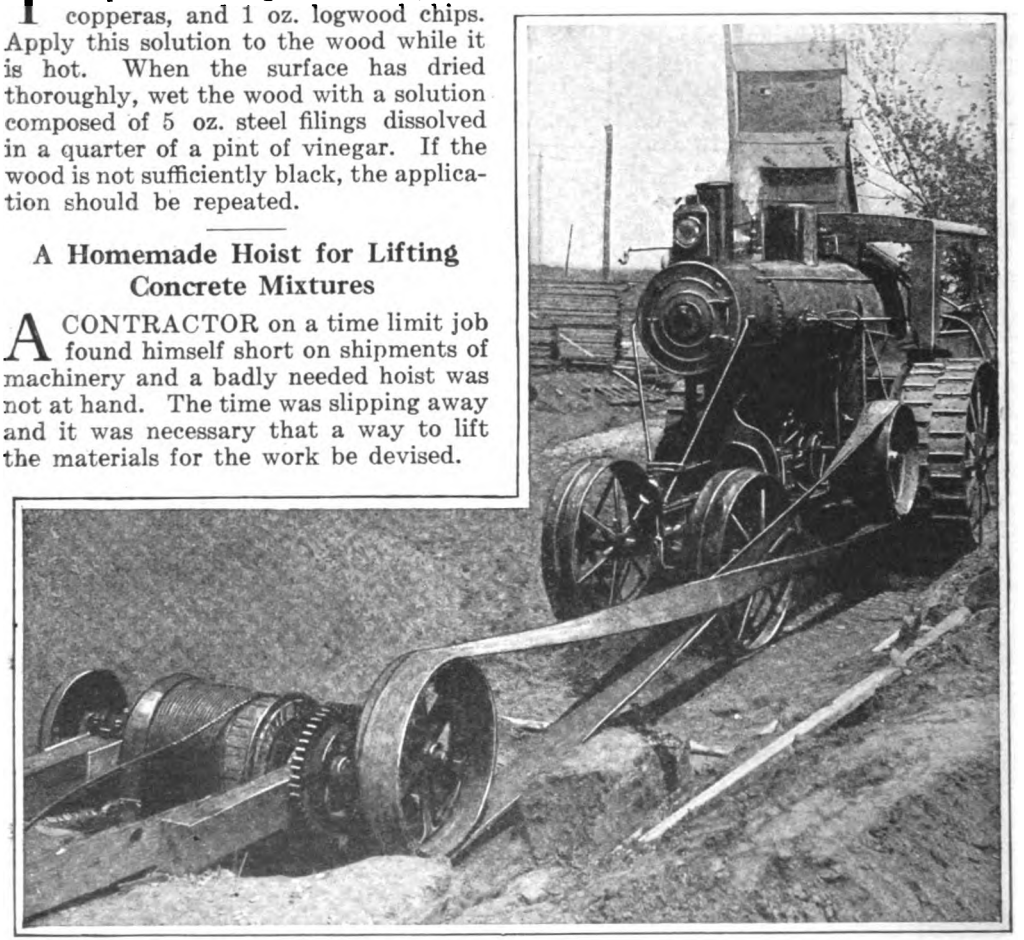
Making a Stain to Give Wood an Ebony Hue

TO a pint of boiling water add ¾ oz. copperas, and 1 oz. logwood chips. Apply this solution to the wood while it is hot. When the surface has dried thoroughly, wet the wood with a solution composed of 5 oz. steel filings dissolved in a quarter of a pint of vinegar. If the wood is not sufficiently black, the application should be repeated.

A Homemade Hoist for Lifting Concrete Mixtures

A CONTRACTOR on a time limit job found himself short on shipments of machinery and a badly needed hoist was not at hand. The time was slipping away and it was necessary that a way to lift the materials for the work be devised.

A local planing mill made a drum for him which consisted of a pine core encased with oak pieces laid on lengthwise. This drum was keyed to a piece of shaft with a gear on one end. The shaft was set in hardwood bearings, bolted to two timbers 8 in. square, which were fastened to stakes driven into the ground. An old pulley with a friction clutch attached was keyed to another shaft, together with a pinion, and set in bearings so that pinion and gear would mesh together properly. A blade was made from a piece of sheet iron and put around the drum and then a foot lever was attached to it. This improvised hoist was driven by a borrowed traction engine to keep the work going until the regular hoist arrived. It was a very satisfactory makeshift.—J. OLIVER HOGG, JR.



A homemade drum and driving gears for a hoist which were driven by a traction engine and used in place of the regular machine on a time limit construction job

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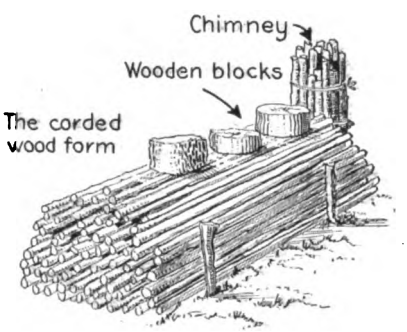
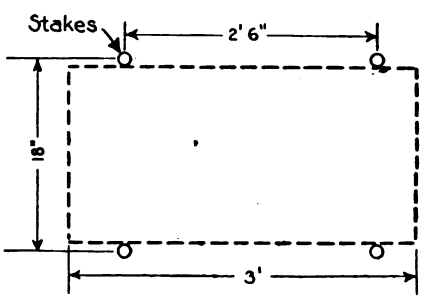
A Camper's Dutch Oven

By J. S. Zerbe

COOKING is always the most difficult problem for the camper. A simple fire made of faggots, a tripod to hold the kettle, or a few stones between which the fire can be built and on which the utensils may rest, are always available for preparing food. But it is just as easy to make a serviceable stove and oven as to adopt either of the foregoing primitive methods. Besides, it is real fun to make such a structure and the device will afford a means for turning out baked potatoes, roasts, and even biscuits without interfering with the cooking in the pans or kettles.

It is especially adapted for localities where stones or rocks are not available, for the material can be found everywhere. A couple of boys can make the stove in two hours, so that the work provides an economical way of putting in time while waiting for the fishing or hunting excursion.





Outline of corded wood

The corded wood form to build the clay over and the ground plan

The size of the oven will depend on the number in the party, although it is well to make it spacious enough, for usually the fuel is plentiful enough for a large oven. The following description gives dimensions for an oven capable of serving two dozen, and at the same time will be serviceable for a half dozen or less.

Gather a quantity of dry faggots, bark, chips, and material of the kind which will easily burn, and let, say, a third of the fuel be green, or partly seasoned. Select four stakes, each 2 ft. long, and drive them into the ground 1 ft., arranging them so that a rectangle is formed, 18 by 30 in.

These posts serve as the holders for the wood to be placed between them. In cording up the wood the dry fuel should be placed at the bottom. The sticks, or the corded pile, should be 3 ft. long, and when laid in should be arched over the top from side to side, care being taken not to pack the wood too tightly, as sufficient room must be left for air to pass through freely from end to end. For this reason leaves should not be used.

When the main cord is complete make a bunch of faggots, also 3 ft. long, and 8 in. in diameter, of dry material, bound in two or three places, so that it will hold together. This is stood up at the rear end, close to the corded pile, and is designed for the chimney.

While the foregoing is being built some of the boys can prepare three drums or blocks of wood, from 6 to 8 in. in diameter, or, better still, three of differ-

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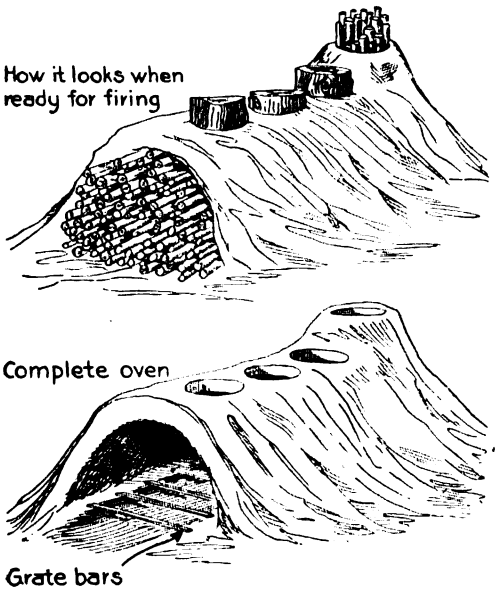
ent diameters. One end of each should be cut off square. These should be about 6 in. long, at least. These three blocks are arranged on top of the cord, spaced about 6 in. apart.



Above, the clay laid over the wood; below, the finished stove after the wood is burned

The clay should now be applied. In the selection of this material considerable care should be exercised, as much depends on its quality and the way it is tempered or mixed. Clay is usually found exposed along the hillsides. Either the blue or yellow variety will serve the purpose.

If the camp is located at a lake where the soil is sandy, and the soft, pasty earth, characteristic of clay formation, is not available, the earth should be mixed with the muck or black fine deposit usually found in the bottom of lakes. In either case, or whatever the material, mix it with plenty of water.

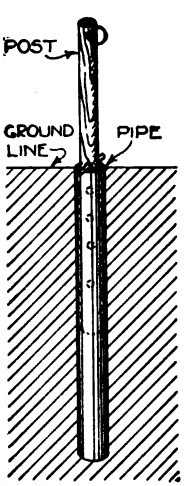
When a sufficient amount has been tempered, cover the corded fuel and the vertical stand with a coating of clay at least 2 in. thick. As fast as the coating is applied follow it up by piling earth against it and tamping it tightly. Be careful to keep the front end of the cord and the top of the vertical bunch of wood free from clay. Every other side and end of the wood should be coated and covered.

As soon as the mound over and around the wood is complete it is ready for firing. The fire will need some encouragement at first, but this is a good thing. Care should be taken not to hurry up the heat. Drying it out with a gentle heat will eventually help the burning. After the fire once starts keep on adding fuel by carefully pushing in faggots. A fierce fire will result. This should be kept up for an hour until a good, strong crust is formed and the blocks on top begin to char through, finally falling into the furnace. The stove is now ready for cooking and baking purposes.

A narrow trench should be dug along the bottom of the fire place, and across this a half dozen or more green sticks may be laid to serve as grate bars. Baking can be done exactly the same as if the dutch oven were being used—that is, by making a very hot fire and afterwards withdrawing it; then, after putting in the articles to be baked, the top, front, and all other openings are sealed up. The heat in the walls will do the work without any likelihood of burning.

A Telescoping Clothesline Post for the Yard

THIS post is for placing in the yard where it can be used for the line on wash day and telescoped into a part that can be set in the ground on other days of the week.



The post enters the ground

The part set in the ground should be 7 ft. long and 1 in. in diameter. Its full length is set in the ground. The pipe to fit in this outer piece is 6 ft. 10 in. long and ¾ in. in diameter. Four holes, ½ in. in diameter, are drilled through the inner pipe into which a small bar of iron is placed to keep it above ground. When the iron pin is withdrawn the pipe above ground falls into the other so that it is entirely out of the way when it is not in use and the lawn is being mowed.—IRBRA H. TAYLOR.

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Simple Designs for Sheet Metal Working

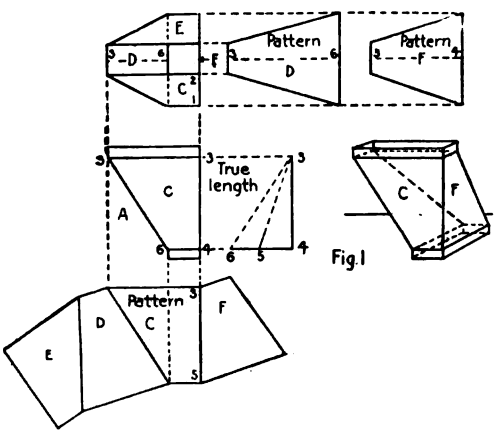
XVI.—Patterns developed by Triangulation

By Arthur F. Payne

Director of Vocational Education, Johnstown, Pa.

THE problems demonstrated in this issue are of exactly the same type as those illustrated in the last issue, the only difference being that they are a little more advanced.

The illustration, Fig. 1, demonstrates the method of developing the pattern

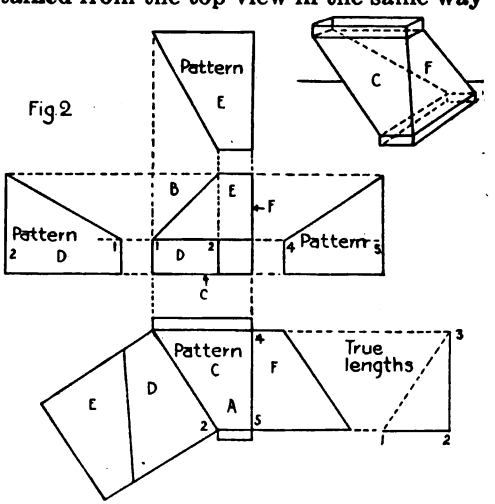


A method of developing a pattern for a compound offset for a hot air pipe

for a "compound offset" hot air pipe by the triangulation method. This offset is used between the floors of a building where the pipe has to be reversed. It is a very simple problem to develop, most of the difficulties being in "visualizing" or seeing the offset from the drawings.

First, draw the front view *A*, then the top view *B*. Second, mark the four sides *C-D-E-F* as indicated. We will first develop the pattern for the side *C*. We must first notice that side *C* of the front view is not a "true view," and that the top is leaning away from us as shown by the distance 1-2 on the top view *B*. To get the true length of the side *C* we must imagine that the line 1-2 is the top view of a triangle, as explained in the last issue. The line 3-4 is the length of the straight side of the triangle. So if we set off on the "true lengths" triangle the distance 1-2 as 4-5 then the dotted line 3-5 will be the true length of the side *C*. Project the width of the top of the bottom down to the pattern *C*, set off the line 3-5 from the true lengths triangle, connect the top and bottom with the long slanting line, and the pattern for the side *C* will be complete.

Now we must get the pattern for side *D*. We can get the true widths of the top and bottom from the top view *B*, as shown. There are two ways to get the true lengths of this pattern, the simplest is to take the length of the line 3-6 from the front view, which is the true length of a line running down the center of side *D*, and set it off as 3-6 on the pattern, then draw the two side lines and the pattern is complete. The triangulation method of getting the true length of side *D* is as follows: Think of the line 3-6 of the top view as the top view of a triangle, set this distance off as 4-6 on the true lengths, we know that 3-4 is the height of the triangle, then the dotted line 3-6 is the true length of the center line, set this off on the pattern for *D*, and draw the two side lines, and the pattern for *D* is also complete. The pattern for side *F* needs no triangulation, the width of the top and bottom are obtained from the top view in the same way



A compound corner offset is here illustrated whose side is developed in two ways

as for pattern *D*. The line 3-4 of the front view is the true length of the center line,

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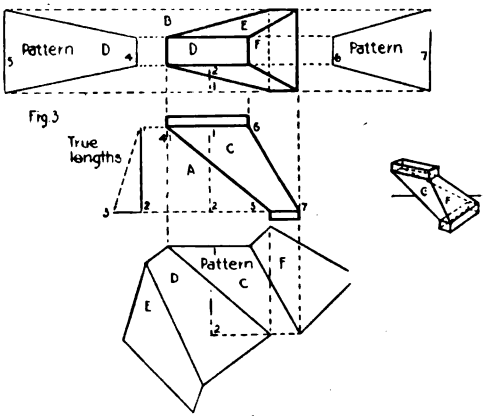
draw the two side lines, and the pattern for side *F* is complete.

The entire pattern for this compound offset is shown. If any of you have difficulty in imagining the shape of this offset place a piece of thin tissue paper over this pattern and mark over the lines with a lead pencil, cut the pattern out, and fold on the lines, and the form of the offset will be before you.

The illustration, Fig. 2, shows the development of a "compound corner offset." This is where the pipe runs up the corner and then has to reverse. Cut the pattern out of tissue paper and you will see its purpose.

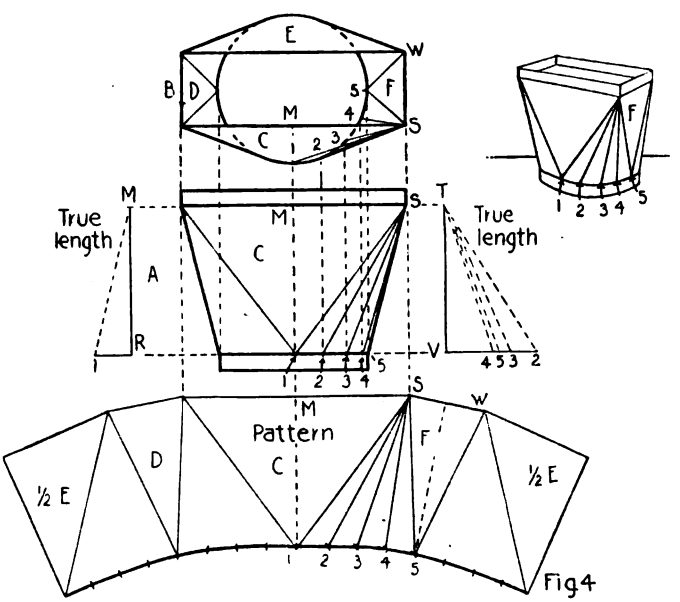


This illustration shows the development for a double offset hot air heater pipe

First draw the front view *A*, then the top view *B*. The front view is already the true pattern for side *C*, as it does not incline either way. The pattern for side *D* can be developed in two ways the same as side *D* of Fig. 1. Line 1-2 of the front view is the true length of the length of the side *D*, the width of the top and bottom is obtained from the top view as shown by the dotted lines. The triangulation method is this: think of line 1-2 of the top view as the top view of a triangle, with the height projected over from the front view to line 3-2 of the true lengths. Set off 1-2 of the top view as 1-2 of the true length and the dotted line 1-3 is the true length of line 1-2 of the pattern. The pattern for side *E* is exactly the same as for side *D*. The pattern for side *F* needs no developing. The widths of the top and bottom being obtained from the top view as shown. The line 4-5 on the front view is the true height of side *F* as shown by line 4-5 of the pattern *F*.

The complete pattern for the offset is shown attached to the front view *A*.

The illustration, Fig. 3, shows the method of developing the patterns for a "double offset." The front view is shown at *A* and *B* is the top view. To get the pattern for side *C*, we make use of an interesting device. Notice that we cannot get the length of the center line as we have done in the preceding problems, so we use an "auxiliary line." We have used these lines before in this series. On the front view *A*, we draw the dotted auxiliary line 1-2. Draw the same line in its proper position on the top view as shown. Now think of 1-2 of the top view as the top view of a triangle, and lay it off as 2-3 on the true length. Project line 1-2 of the true length from 1-2 of the front view. The dotted line 1-3 will be the true length of line 1-2. Now project the width of the top and bottom down to the pattern.



A real problem in triangulation will be found in developing a pattern for a single boot for a ventilating pipe

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Set off dotted line 1-3 as auxiliary dotted line 1-2 of the pattern, draw the side lines, and the pattern for side *C* is complete.

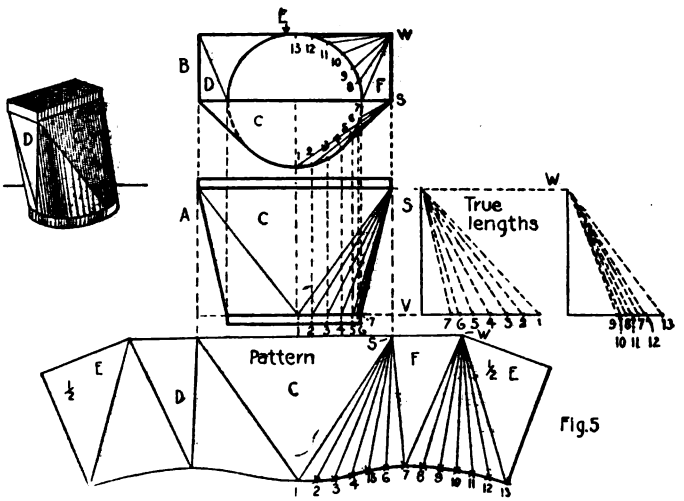
The patterns for the other sides are developed the same as in the preceding problems, and need not be described. Similar lines are indicated by similar numbers.

The problem, (Fig. 4), of the development of patterns for a "single boot" for a ventilating pipe, is a real problem in triangulation. This so-called "boot" is really a transition piece for a ventilating pipe that changes from round to oblong. Cut the pattern out of tissue paper, and the purpose of the piece will be more easily seen.

Draw the front view *A* and the top view *B*. Now it will be seen that the boot has four large triangles, one on each side as shown in the sketch. The small triangles 1-2-3-4-5 would not be apparent in the finished boot. It will only be necessary to develop one quarter of this pattern, as all four quarters are alike.

We will first develop the pattern for the large flat triangle *C*. Project the width of the top down to the pattern. Now we must get the true length of lines 1-*M* of the front and top views. The top of line 1-*M* of the front view is slanting away from us. It slants exactly as much as line 1-*M* of the top view is long, so we have the two sides of our triangle and it will be very easy to find the third. Set off line 1-*M* of the front view as line *M*-*R* of the true length; next set off line 1-*M* of the top view as line 1-*R* of the true length; then dotted line 1-*M* of the true length is the true length of line 1-*M*. Set it off as line 1-*M* of the pattern, and draw the line 1-*S*. We could have found the true length of the line 1-*S*, and not bothered about line 1-*M*. In Fig. 5, we shall use that method.

Notice that there is another large flat triangle on the end of the boot, this is marked *F*, but in between there is a curved part that must be developed first. This part can only be developed by considering it as being broken up into a series of small triangles, as shown in the sketch. Then we develop the pattern for each one of these small triangles.



Another method of developing a pattern for a single boot used as a ventilating pipe wherein the true lengths are found in another way without certain lines

To break up the curved part into small triangles, divide one quarter of the top view circle into four equal spaces, and number the points as shown. Draw lines from these points to the corner *S*. Project the points from the top circle down to the front view of the circle as shown and draw the lines of the triangles to the corner *S* of the front view. Some of these lines are slanting towards us and some are slanting away from us, but the method of getting the true length is the same as we have been using in the preceding problems.

Set off the height of the boot as *T*-*V* of the true lengths; this gives us one side of our triangle. The distance from *S* to the numbered points on the top view circle will give us the other side of the triangles, and we can then easily get the third side as represented by the dotted lines. So set off the distance *S*-2 of the top view as *V*-2 of the true lengths. The dotted line *T*-2 is the true length of line *S*-2. Set your compasses to this distance and from point *S* on the pattern strike an arc. Set a small pair of compasses to the distance 1-2 of the top view circle, and from point 1 of the pattern

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strike an arc across the other arc from point *S*. Draw the line 2-*S* on the pattern. Now we repeat this process exactly for lines 3-*S*, 4-*S*, 5-*S*. Then draw the curved line on the pattern connecting these points.

Now we have to get the pattern for triangle *F*. Set your compasses at distance *S*-*W* of the top view and from point *S* of the pattern strike an arc. Notice that the two lines *S*-5 and *W*-5 of the top view are exactly the same; so take the distance *S*-5 of the pattern and from point 5 strike an arc at *W* of the pattern, then take the distance *S*-*W* from the top view and strike another arc from *S* of the pattern. Draw the lines *W*-*S* and *W*-5 and the pattern for triangle *F* will be complete.

Now we need develop no more of the pattern, since the dotted lines down the center of triangles *C* and *F* indicate one quarter of the pattern. Simply lay this one quarter over three times and the entire pattern will be complete as shown in the drawing.

The flange at the top of the boot can be added to the pattern. The flange for the circle at the bottom must be made and put on separately.

The illustration, Fig. 5, of the "single offset" boot is merely a repetition of the development just described for Fig. 4, the only difference being that it will be necessary to develop one half of the pattern instead of one quarter as was done for Fig. 4, also that two sets of true length triangles have been drawn to avoid confusion of lines.

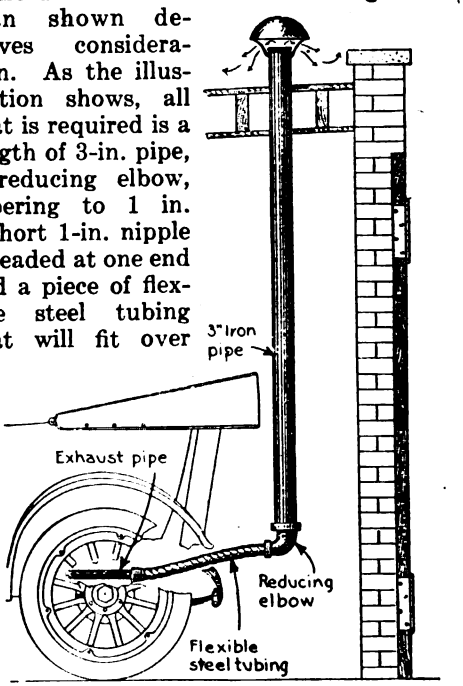
The steps stated briefly are drawn front view *A* and top view *B*. Lay off the top circle into twelve equal spaces, connecting points with points *S* and *W*. Project width of triangle *C* down to pattern, find true length of line 1-*S* by setting off 1-*S* of the top view as 1-*V* of the true lengths. The dotted line 1-*S* of the true lengths being the true length of the line, set it off as 1-*S* of the pattern. Repeat this process to get the true lengths of the other lines, getting the distances between 1-2-3-4 etc. of the pattern from the same numbers of the top circle. The full pattern is shown in the drawing.

Several inquiries having come to the editors of POPULAR SCIENCE MONTHLY and to the author of this series, regarding the methods of developing patterns for automobile parts, such as hoods, seats, bodies, fenders, etc., notice is hereby given that full drawings and demonstrations for the development of patterns for the parts will be given later in the logical place in the series. Any other suggestions will be gladly received.

(To be continued)

Simple Way of Removing Waste Gases from the Garage

THE exhaust gases emitted by automobiles in closed garages sometimes cause death. In view of this danger the plan shown deserves consideration. As the illustration shows, all that is required is a length of 3-in. pipe, a reducing elbow, tapering to 1 in. a short 1-in. nipple threaded at one end and a piece of flexible steel tubing that will fit over the end of the nipple and slip over the end of the exhaust pipe in the rear of the automobile. The waste gases are carried by the flexible tubing to the 3-in. pipe, which leads to the outside through an opening in the roof of the garage and has a mushroom cap to keep the rain from entering the garage through the pipe. The location of the pipe may be at the back of the garage or at one side at the front, if the car is driven in and not backed in.—MICHAEL J. F. SCHRAMM.



A built-in connecting pipe to carry away exhaust gases from a housed automobile

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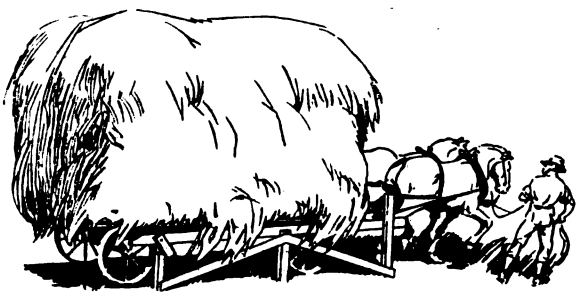
A Jack Frame for Lifting and Holding a Wagon Rack

IT usually requires three or more men to unload the rack from the trucks or to lift the rack on the wagon. This change must be made at least twice a year and in some cases several times a month. With the device shown it is only a one-man job.



A load of hay being driven on the timbers to take it from the truck

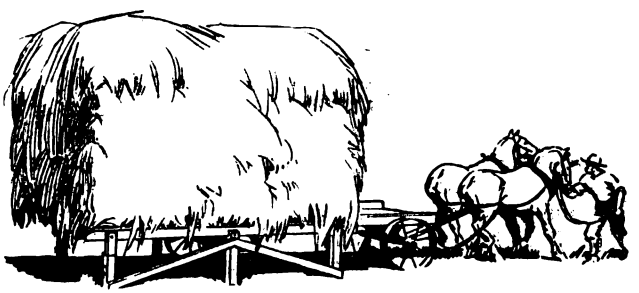
To unload the rack from the wagon, drive in at the low end and the rack slides up the incline and is raised from the trucks. Attach a heavy cleat on each side of the rear bolster so that it will not slide back. The skids are pivoted on the center posts so that when the rack is far enough ahead it will rise from the wagon. The 2 by 4-in. props will then rest directly on top of the short posts and the rack will be set aside until the need arises to use it again.

To load the rack on the wagon, back in at the high end of the device and knock out the swinging props from the short posts. Then pull the rack down on the trucks or the rear bolster.

The device must be made to fit each rack size. Ordinarily the 2 by 8-in. skids will have to be made 20 ft. long. The distance from the center post to the high one will be about 1 ft. more than from the center post to the short post. Brace the posts well with 6-in. fence boards. Set the posts at least 2 ft. in the ground and tamp them well. A little creosote or tar painted over the buried ends will prevent rot or natural decay. —W. E FRUDDEN.

A Rat Trap Made of a Board Placed Over a Tub or Barrel

THIS is rather an improvement on the old tub-of-water rat-catcher. The tub is partly filled with water, and in the center there is placed an upright object, on which the bait, cheese or other food is fastened. On one side of the tub a piece of shingle is attached on a spring pivot, with the thick or heavier part next the edge of the tub. This piece should be short. A piece of lath will do as well as the shingle. A piece of board is laid to the tub to form a path for the rat to walk on. When the rat gets on the shingle and walks towards the bait, down he goes into the water, of course, and his squeals of fright cause other rats to come and meet their fate. We have known of an entire family of rats being drowned in this way, in one night.—A. A. KELLY.



To load the rack on the truck it is backed in between the timbers knocking out swinging props from short posts

Asbestos Covering for Steam Pipes to Save Coal

IN a large wood working factory where a 312 k. w. heating and power plant was used it was found that a saving of 22 tons of coal was obtained by giving the 111 sq. ft. of exposed pipe surface a covering of two layers of asbestos board each 1/8 in. thick and a layer of 85 per cent magnesia covering. The bare pipe gives off 3 b. t. u. per square foot of surface per hour per degree of difference in temperature between the steam and air. This plant lost 88,000 b. t. u. each hour. This reduced to cost of coal per ton gave the amount of tonnage mentioned.

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Anchoring a Barrel on a Barrow to Prevent Its Overturning

AN iron hook attached to a cord long enough to permit its being slipped between the staves and over the hoop

The barrel is held to the wheelbarrow bed with cords and hooks to prevent its overturn

of a produce barrel will anchor it to the barrow quite securely. In fact, a series of four cords and hooks will allow a full barrel of this type—even wider than the barrow—to be wheeled up and down hill without danger of its tumbling off. When cleaning up around the lawn or garden a barrel is often more convenient since it holds more than the small garden receptacle. The only drawback is the danger of its falling off, an accident which this holding means will prevent. The cords and hooks can be easily removed when not in use.—JAMES M. KANE.

A Simple, Effective Way to Cut Glass Tubes and Beakers

FIRST, with a sharp triangular file draw a fine line across the tube. Then, holding the two ends of the tube firmly in the hands, bend it, pulling the two ends or halves apart at the same time, and it will crack at the scratch usually with a smooth edge.

If the tubing is thick, it may be necessary after making the scratch, to start the crack by means of a red-hot bit of glass—for instance, the end of a stirring-rod which has been heated over the flame of a lamp.

To cut a large glass tube or beaker the following method is advised: Make a fine scratch by means of a file, wrap around the tube two pieces of damp paper with straight edges facing each other, but a slight distance apart, so as to include the scratch in the gap between. Then, by means of a finely-pointed flame, start the crack at the scratch and carry it around the tube.—PETER J. M. CLUTE.

Guide Blocks to Start Taps in Soft Metals

TAPPING fine holes in brass, copper or lead with the small taps is a very difficult task for the amateur mechanic. Either the tap is broken or the hole is reamed out instead of being tapped. The reaming is caused by not applying the right pressure. When this is not the case the tap wabbles in turning and is apt to be broken. These difficulties may be overcome by following the plan shown in the illustration. This guide will not let the tap wabble and it will apply the right pressure to start it into the hole. All that is necessary for the amateur to do is to turn the tap handle.

The device consists of steel blocks about ¾ in. long, ½ in. wide and 3/16 in. thick. A hole is drilled in each block for a tap size and the hole threaded. When threading a piece of brass, copper or lead, the tap should be screwed in the block

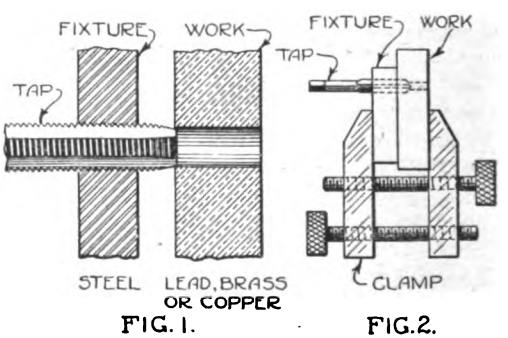

FIG. 1. FIG. 2.

Guide for a small tap to start it in soft metals and keep it straight in the hole

far enough so that the nose of the tap projects just a trifle; then take the piece to be threaded, place the nose of the tap in the hole and clamp the two pieces together. Turn the tap without applying any pressure and it will start and cut the threads straight without danger of reaming.—THEODORE P. GATHMANN.

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An Old Truck Becomes an Amusement Thriller

By P. P. Avery

A GOOD second-hand, two-ton auto-truck of reputable make, and the attachment here shown produces a money-making amusement device for traveling from place to place and taking in the country fairs and places of amusement. If there is no cab on the driver's seat, build one and provide side curtains and a wind shield. Under the seat cushion will be found space for an extra set of batteries to be used for emergency lighting or ignition. Tools, oils and greases may be carried in the rear tool box.

Remove the old body from the truck and attach a good strong floor to the frame with sides extending 6 in. Continue the running boards to the rear wheels allowing 6 in. of clearance. Bolt on top of these boards drawers or boxes and attach some more drawers underneath for carrying supplies and provisions. Use a good three-burner gasoline or kerosene stove for heating frankfurters, etc. This is to be located on one side, and on the opposite side is a peanut roaster.

Supplementary to the ignition of the motor add a generator driven from the fan pulley on the crank shaft. This may be done by changing the pulleys to double drive, using round leather belts, one to the fan and one to the generator. From the generator run wires to the headlights and to the lights of the merry-go-'round, and on the side directly behind the cab build a lunch counter which is hinged so that it may be let down during transportation. Attach to the side of the cab vending machines, such as chewing gum, salted peanuts, etc. Provide a special felt-lined box for carrying dishes, knives, forks and spoons.

The frame of the merry-go-'round is built of 3 by 3-in. angle iron with a cross brace in the center of the same material, which is riveted to a ¾-in. plate at the top. The side pieces are made to take down, using ¾-in bolts throughout. Use two lengths of channel iron with 1-in. bolts at each end, over which is looped 1-in. rods which support the two 1-in. rods around the seats, which consists of chairs with the legs removed. The frame is secured to the chassis by ¾-in. rods. Make a set of 5 steps and provide two hooks to fasten them to the rear cross member of the truck frame. Use ⅞-in. pine wood for this construction, also for the boxes, drawers, lunch counter, etc. A frame of ⅜-in. gas pipe is used for supporting an awning or canvas roof over the lunch counters. The rods to slip into the holes in the pipes are bolted to the chassis and secured there with ¼-in. set screws. Old porch awnings may be used for this purpose.

An old mill pulley wheel and two bevel gears with a 2-in. shaft about 11½ ft. long are used for the driving mechanism. Provide set screw washers and heavy brass washers at the top and bottom for the thrust bearing, lubricating with heavy oil. Drill a few holes in the brass so that the oil or grease may be retained. Use a 5-ton jack and raise one rear wheel about ½ in. from the ground. Remove the earth from under the wheel, place blocks with hold-fast irons in front and rear of the other three wheels, driving the 18-in. rods into the ground to prevent

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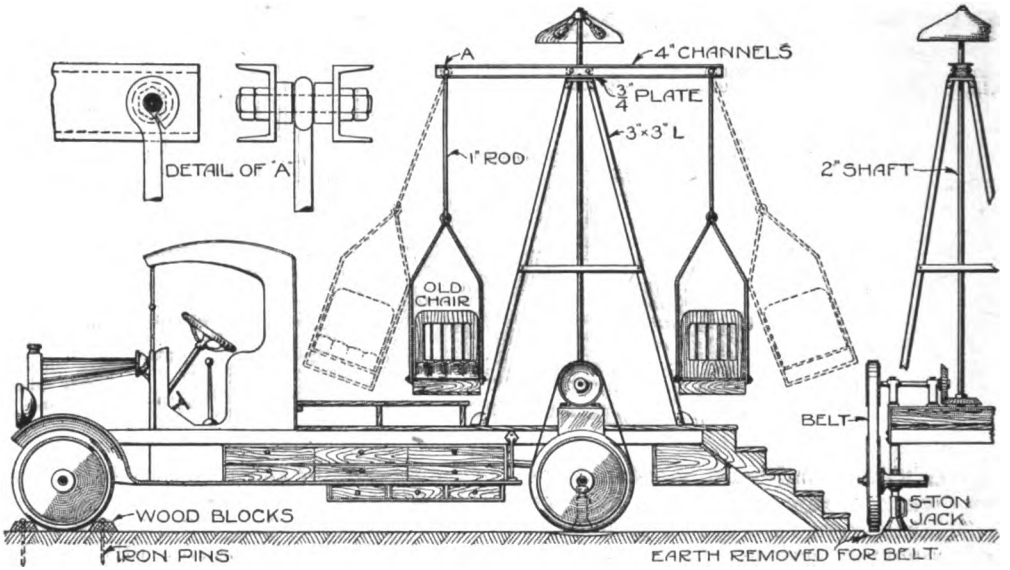


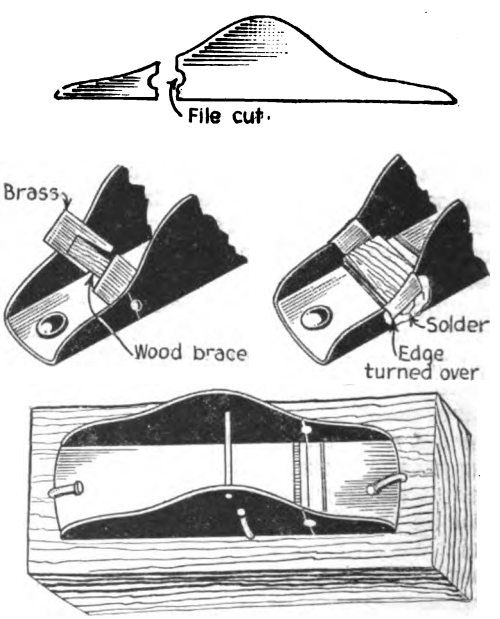
Framework mounted on the rear part of a motor truck which carries a revolving bar with two suspended seats to make swings, all driven by the power plant of the truck

the car from moving, attach a slip on belt 4 in. wide of good leather and operate the merry-go-'round by shifting to low gear and drive the same as if driving on the road. Throttle down the motor to produce the correct speed for the swing seats. This novel feature combined with the other accessories makes it possible to visit all county fairs, race tracks, parties, etc., and earn good money on the investment. The parts may be bought cheaply second-hand and when completed given a coat of good paint.

Repairing the Metal Body of a Broken Plane

A METAL body plane broken by a fall was too good to be thrown away and it was decided that a repair could be made with the use of solder. The break was in such a place that a cross brace would interfere with the egress of the shavings. Each edge of the fracture was filed with a round file to form a pin of solder, as the inner edges of the break could not be soldered as that would destroy the shape of the plane. The inside and outside surfaces were filed clean and two pieces of sheet brass were wedged in with a piece of wood. Before doing this both surfaces were tinned.

The plane was firmly mounted on a block and fastened with finishing nails. The soldering iron was applied long enough to heat the metal properly to flow the solder, then the upper ends of the brass pieces were turned over the plane edges and soldered. After filing up the edges and solder neatly the plane was as good as new.—JAMES M. KANE.



The break in a plane and how it was prepared to join the parts with solder

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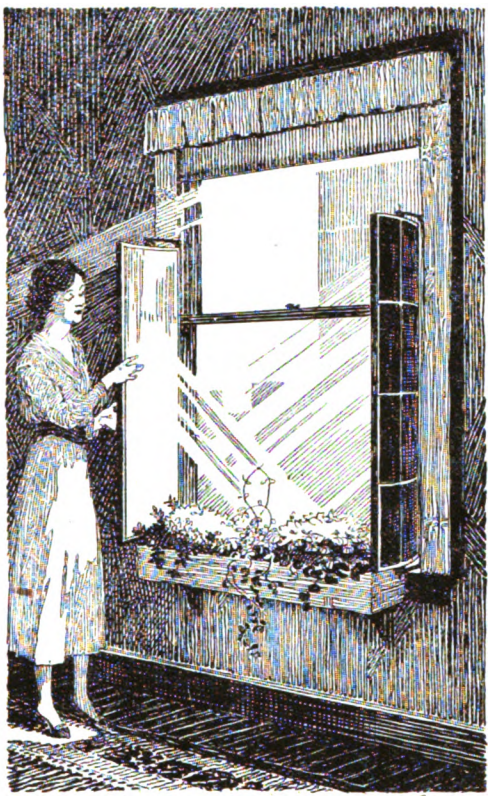
Reflector Made of Tin to Cast Sunlight on a Window Box

NOT every window in apartments can face the sun. Sometimes, even when they do, buildings, shading them, keep the light away from window boxes, to the detriment of the growing plants. To provide a means of throwing the sun's rays on the boxes, a reflector made of tin was provided for each side of the window, as shown in the illustration.

The reflectors were pivoted at each end so that they could be adjusted to the right angle of light. They were made slightly concave and of tin, polished to make the reflection required. The edges were trimmed with thin wood molding mitered at the corners and the back was braced with cross ribs cut to the curve desired. A coat of black paint was applied over the ribs and the entire back of the tin. A long metal curtain hanger rod was used for the support between the brackets. The ends of this rod served as bearings fitting in round holes in the brackets.



The reflectors can be turned to throw the rays of sunlight upon the growing flowers

Cleaning the Lime from Gold Fish Globes

DO not use soap or scouring powder to remove the streaks of lime or other mineral deposits found on the top of your gold fish globe, caused by slow evaporation of the water. Soap or scouring powder is injurious to the fish if any particle remains on the globe. Use common salt. Salt is not injurious and answers the same purpose.

Heat-Treating Steel When Doing Experimental Work

IN model building and experimental work it often becomes necessary to harden a piece of steel and temper it to a definite degree of hardness or soften a hard piece such as a spring so it can be drilled or machined, and a few simple experiments in heat treatment of steel are sufficient to enable one to obtain the desired results.

Secure a piece of spring steel wire about 3-32 in. in diameter and 3 ft. long. Heat about 2 ft. of it to a dark red color and allow it to cool slowly in the air. This will anneal the wire so it can be hammered easily. Hammer it flat to a thickness of about 1-32 in. and smooth the surfaces by grinding or filing. Heat the flattened end of the wire to a light yellow color and let the red color extend about 3 in. from the end, allowing a gradual change in color from the end to this point. Cool the wire quickly by dipping it suddenly endwise in water as soon as the desired color is obtained.

With a pair of pliers, or a vise, break off about ½ in. of the end of the hardened piece and notice the grain of the fracture. Break a second piece and compare it with the first, then a third, etc., till the wire bends without breaking, comparing each fracture with the previous ones. You will notice that the part of the metal which was the hottest is always the most brittle and breaks easier than the part which was colder. At some point between these two extremes there is a fracture which is of fine grain and has a

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silky appearance. That part of the metal which shows the finest silky grain and is too hard to be filed was heated to the proper temperature.

Repeat the operation this time, trying to heat about 5 in. of the piece to the proper temperature, which is something near 1450 deg., depending on the quality of the steel. This time test the texture of the grain as before and determine whether the proper temperature was maintained to produce the finest grain and hard metal. When the proper hardening heat has been determined and the piece hardened properly, tempering is next in order, that is, reducing the hard brittle metal to a tough pliable state suitable for a spring, punch cutting tool or whatever is desired.

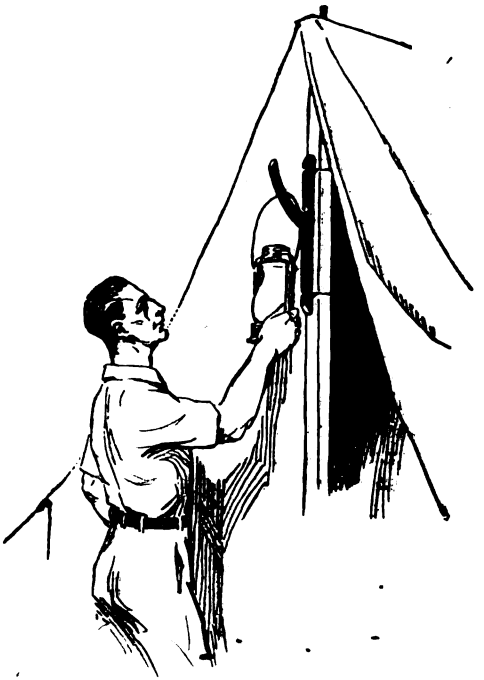
Remove the scale or oxide by grinding or polishing the hardened part of the wire with a piece of emery cloth, soft brick or an emery wheel. Heat slowly about 2 in. of the end and notice the oxide colors as they appear on the surface. As the temperature increases the first noticeable change will be from the original, polished gray to a light yellow, then a straw, brown, purple, blue, etc., till the piece becomes very soft again.

While heating, move the piece about in the heat so as to draw the end to a gray blue and about 3 in. or 4 in. from the end to a light yellow. Between these points the entire color scale will appear and indicates to what degree the particular part was last heated. If the piece was hardened properly the color on the surface indicates the degree of hardness. With a pair of pliers break and examine the pieces as before. In this case it will be noticed that the part which attained the highest temperature is the softest and that the part which has turned to a blue gray will bend easily before breaking. By studying the colors, their corresponding temperatures which are given and the physical qualities of the steel, any desired degree of hardness may be obtained with comparative ease.

Faint Yellow	430 deg. F.
Straw	450 deg. F.
Dark straw	470 deg. F.
Brown	490 deg. F.
Dark brown	510 deg. F.
Purple	530 deg. F.
Blue	560 deg. F.
Gray blue	610 deg. F.

A Clothes Peg Cut from a Limb for the Camper

CAMPERS seldom provide a means of taking care of clothes, but the woods furnish the required material if



A peg made of a Y-branch from a tree and attached to a tent pole for a hanger

one cares to take a little time for the making of a clothes peg. Look around and find a Y-branch on a suitable size limb; cut it so that the arms forming the Y-part are about 3 in. long and the lower end 4 or 5 in. long. The long part is lashed to a tent pole, as shown, and the extending branch makes the clothes peg.

Coloring White Roses Blue with a Chemical Preparation

THIS transformation may be readily carried into effect by submerging the stems of white roses in a solution prepared by dissolving a little more than ½ oz. aniline methyline dye in half a pint of water to which some saltpeter has been previously added. The saltpeter acts as a preservative, and the flowers will last for a considerable time in this condition.

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Making a Flying Model Airplane

by Charles H. Hubbell

THE body or fuselage of the model airplane is constructed of spruce sticks ⅛ in. square. The four main beams, or longitudinals, are each 22 in. long. In making the body it is well to lay the four sticks side by side, and mark the places where the struts, or distance sticks, are attached. Then the two sides of the body are constructed, the dimensions being as shown in the illustration. It is a good plan to bind the two rear ends of the two sides together first and then fasten in the sticks at the front end. The longitudinals can then be spread until the other struts are inserted in their proper places. It may be necessary to steam or soak the sticks in water in order to get them to bend without breaking. The sticks are fastened together by means of short pins, the holes for them being bored with a small drill. After the two sides have been constructed and shaped as shown, they are ready to be fastened together. The rear ends should be separated by a stick 1½ in. long, and two sticks, each 3 in. long, should be fastened between the two sides at the front end of the fuselage. The other distance struts can then be inserted at regular intervals.

As the woodwork of the fuselage is now complete, the landing gear is next in order of construction. This part is constructed with a central member consisting of two sets of V-shaped braces connected at their vertices by a straight cross-member. The sticks which go to make up the braces are each 3 in. long. The connecting stick is 4½ in. long. In completing the landing gear, two sticks 3½ in. long are fastened to the fuselage. These extend downward and their lower ends are bored to receive the axle. Two more sticks, each 4¾ in. long, are fastened to the bottom of the rear brace and extend forward to the ends of the axle. The ends of these sticks also are drilled to receive the axle, which is then placed in them. When inserting the axle, the sticks which run from the fuselage down to the axle should be put on the outside, that is, the side closest the wheel. The axle is bent up in the center and bound with fine wire, or strong thread, to the forward brace. The two sticks which slip over each end of the axle are also bound tightly together and soaked in glue. All other joints in the landing gear should be treated similarly. The wheels which are fitted to this model are the 2-in. miniature airplane wheels with pneumatic tires. Axles can be made of strong, stiff wire, such as a bicycle spoke, or they can be purchased from dealers in these materials.

The motor-stick for this model consists of a piece of spruce ¼ in. square and 24 in. long. It is fitted with a hood at one end and a propeller-hanger at the other, as shown. The propeller is made of a block of wood, 10 in. long, 2 in. wide and 1 in. thick. It may be possible for the builder to purchase a 10-in. blank, then the blades can be easily cut out with a knife. The blades should be very thin and slightly cupped, for best results. The propeller-shaft can be made from a bicycle spoke, bent to the proper shape. About 4 oz. of 1/16 in. square rubber is used in this model. This can be purchased from a model supply house; or rubber bands to the required amount may be strung together. After completing the motor-stick, mount it to the fuselage and bind underneath the front and the cross-stick

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next to the last one. This is shown at *AA* in the illustration.

When the motor has thus been fastened in, the fuselage may be covered. Bamboo fiber paper is used for this purpose. It is slightly dampened before its application and is then glued to the sides of the fuselage first. The overlapping edges are trimmed close to the sticks with a sharp knife and the whole is then set aside until it is dry. In drying, the paper will shrink slightly, stretching over the sides of the body and making a smooth, taut surface. The top and the bottom of the fuselage are covered as far back as the rear end of the motor-stick so as to give ready access to the hook for attaching the rubber.

While the process of drying is going on, the hood for the front section can be made. The hood only affects the appearance of the machine and is not necessary to a flying model. The large machine, however, is fitted with such a hood enclosing the motors, and it is for this reason the hood is shown. It is cut from light, stiff cardboard, as shown in the pattern. The sides and top are cut from one piece, while the front is cut from another that is semicircular in shape. The flaps on the piece which forms the sides and the top are bent over after the hood is in place. These serve as a foundation to which the front piece is glued. In the corners of the hood at the places marked with small crosses, pins are inserted and are driven into the fuselage-sticks, thus holding the hood in place. Glue can also be used in connection with the pins if desired, and its use makes the hood remarkably rigid and solid. After this part of the hood has been attached, the flaps on the forward end are bent inward towards the center and the front piece is glued to them. The whole hood is then given a coat of shellac, or light varnish, and set aside to dry.

The planes are constructed in two sections, one section for each side of the body. Each plane has two main beams ⅛ in square and 21 in. long. There are five ribs 6½ in. long ⅛ in. wide and 1/16 in. thick in each plane. The curvature for these ribs is obtained by soaking them in water for a short time until they become wet through and then clamping them in a form and holding them in a gas flame until they have been thoroughly steamed. When cool they can be taken out of the clamps and they will hold their curve permanently. The main beams are laid side by side and the places for the ribs marked with a pencil. The ribs are then laid on the beams and tied to them with strong thread. The front beam should set 1 in. back from the front end of the ribs, while the rear beam should be 4 in. back of the front beam and 1½ in. from the rear end of the ribs. The edges of the planes are made from the same size stock as the ribs and are tied to the ends of the ribs in the same way as the main beams are attached. The rear or trailing edge is 19 in. in length and the forward or entering edge is 16 in. in length. The end of the wing is formed of a piece of rib stock, which is bound on top of the plane edges at their ends and is tied to the bottom of the main beams where it crosses them. The main beams are then trimmed off where they project over the end; then all joints are glued and the framework is left to dry.

Now the tail and the rudder are constructed practically in the same manner. A piece of ⅛-in. rattan reed is used for the curved edges of the rudder. The planes, when dry, must be covered with bamboo fiber paper, slightly dampened. They are single surfaced, that is, covered on the upper side only. The paper is cut slightly larger than the framework and the overlapping edges are turned over the plane edges and glued.

The planes are then fastened to the body and the brace wires put in. In attaching the planes the forward main beam is run across the top of the two upper fuselage-sticks while the rear beams is passed underneath these sticks. In this way the planes are given the correct angle to make the machine take to the air from a run on the ground. The main beams are connected by pieces of ⅛-in. square aluminum tubing, as shown in the illustration. The wires used in guying should be about 36 or 40 gage. In bracing the wings care should be taken not to warp them out of shape.

In flying the machine, wind propeller a few turns, so that if the balance of the machine is not correct it can be rectified before any damage is done. The propeller can be wound up perhaps 50 turns for a test and the model set on any smooth,

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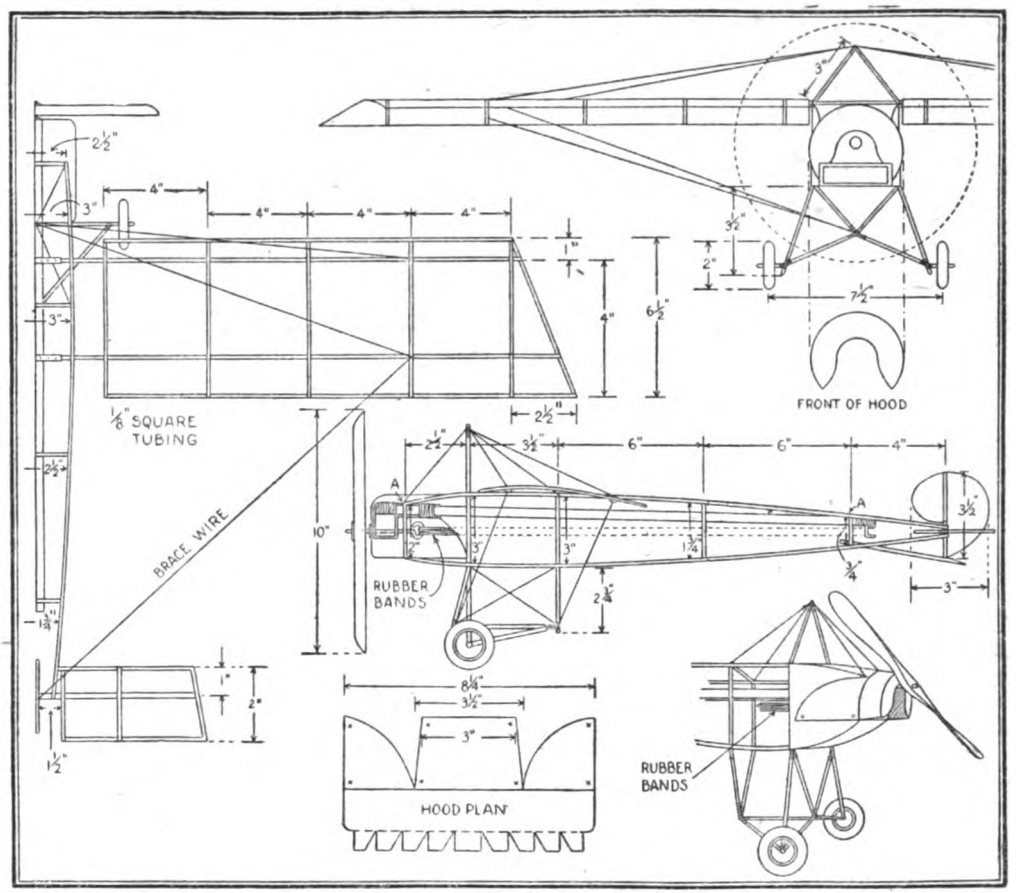
hard surface, such as a sidewalk, pavement or the like. When the propeller is released, the model should run along on the ground for a few feet and then mount into the air and fly along on a level keep for perhaps 25 ft. If the model does not do this the balance is not right and must be corrected before making further trials. If the machine climbs perpendicularly, or nearly so, and after losing headway, falls tail-first, the main planes should be moved backwards. If the model does not rise at all, either the rubber should be wound tighter or the main frames moved forward a trifle. A little experimenting will soon give the correct position, and then many flights can be made without alteration. A model such as this will fly a di nc o about 100 ft. on 300 turns of he rubber, although it is capable of much longer flights. This model is speedy and fairly steady in flight, provided there is little wind; but because it is speedy, and therefore sensitive, flying it in windy weather is not advisable. The prettiest flights can be made by letting the model rise off the ground under its own power, but flights made in this way are never very long, as a great deal of power is used in the starting. If longer flights are desired, the model can be held on about the level of the eyes, with the right hand holding the fuselage just back of the landing gear, and the left hand holding the propeller to prevent it from turning until released. When released the machine should be given an easy throw forward in a slight downward slant. The model will then glide forward a few feet, pick up speed and fly off.



Model flyer details which make a self-propelling machine that will fly in a realistic manner for many feet. The power plant consists of heavy rubber bands

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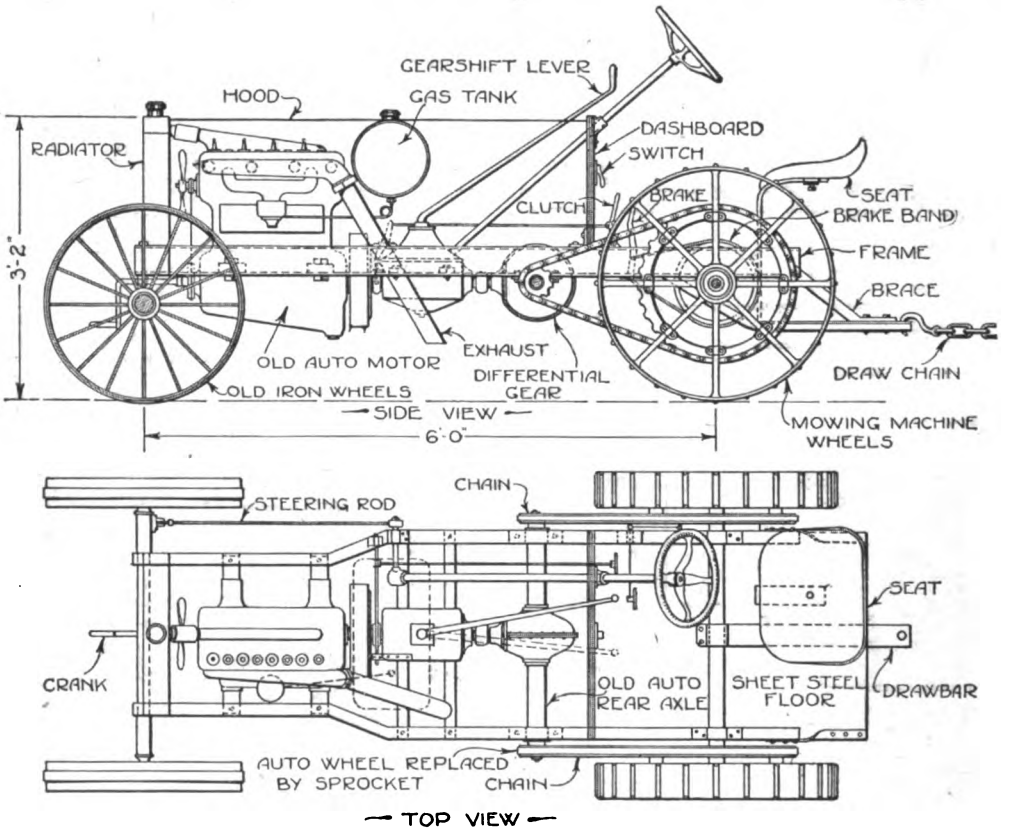
A Farm Tractor Made of a Wrecked Automobile

FARM work is becoming more mechanical as the years pass by and the problem of most interest today is the mechanical horse. Tractors of various designs have sprung up in the past few years, and the farm owner will soon be considered without progressive spirit if he does not own at least one power-operated pulling machine. Some farmers have considered these facts and where they do not have sufficient funds to purchase a tractor they have managed to construct one from discarded farm machinery. These machines can be made as elaborate as the owner desires, using a purchased automobile engine for the power plant. The illustration is that of one in which the power plant was purchased from a dealer who had a wrecked car.

The frame was made of 4-in. channel iron, strongly braced and cross braced with band iron riveted in place. Under this frame the front and rear axles were mounted. These were made of the ordinary heavy wagon axle, irons. The front axle was made to swivel on two plates, as shown. Grease retaining grooves were cut in the surfaces of the plates. A 1-in. king bolt of fine steel was used for the axis. The motor and transmission gear case were installed intact, the drive shaft being cut down to engage the differential gear case and the rear axle housings cut and keyways made in the axles to receive the sprockets. The large sprockets were obtained from a junk dealer at small cost and were clamped to the spokes of the mower wheels.

Springs are not necessary as the tractor rides over soft earth. The gasoline tank is held in position by ¼ by 1-in. band iron brackets bolted to the frame.



An old wrecked automobile furnished the power plant for this homemade tractor which, when complete, works as well as an expensive tractor and will draw all farm machines

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The gear shift lever is elongated by welding a piece on it and shaping it as shown. A heavy galvanized hood should be made to cover the engine and transmission. If the builder is not familiar with sheet metal work any tinsmith can make it.

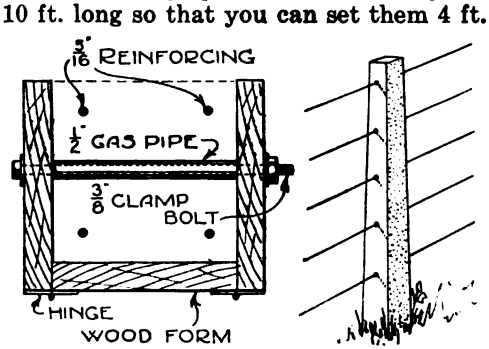
The cutting off of the automobile drive shaft and rear axle ends and the fitting thereto of the sprockets should be done in a machine shop. The draw bar is a 1 by 3½ in. by 4 ft. long iron bar with a ⅞-in. hole for the hook.

The seat is an old mower seat bolted to the frame. The clutch is operated by a push rod and pedal and the brake is made by fastening an old mill pulley wheel to the spokes of the large rear wheels and fitting on a brake band and lever, which should be made of asbestos brake lining riveted to a 1/16-in. band steel and coupled to a ⅜-in. draw rod and thence to a pedal. The engine control should be a fixed spark, and wheel sector placed on the gasoline throttle.

In setting the radiator in the frame, place a piece of heavy spiral spring ¾ in. long under each lug to keep the vibration from fracturing the tubes. This tractor, owing to its decreased gear ratio, will develop unlimited power and with proper care will do much more work than three horses.—P. P. Avery.

Concrete Posts for Grape Trellis or Farm Fence

It is an easy matter to make concrete posts for the grape trellis, or farm fence. For a grape trellis make the posts 10 ft. long so that you can set them 4 ft.

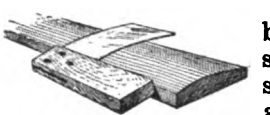


A form made of boards for holding the concrete mixture to form a fence post

underground. The butts should be 6 in. square and the tops 4 in. At equal distances apart through the posts are set ½-in. pipes so that you can run the wires through them. The illustration shows how the forms are made. A ⅜-in. bolt runs through the pipes so that the forms will be clamped well and the concrete will not bulge. Mix the concrete with 1 part cement, 2½ parts clean sand and 3 parts well graded gravel. Place four rods, one in each corner for reinforcing. These bars should be at least 5/16 in. in diameter. For the end posts you should have ⅜-in. eye bolts to run through the pipes in the post. This will enable you to fasten the wires securely and also to tighten them.—W. E. Frudden.

How to Make a Flexible Try Square for Curved Work

A try-square with a flexible blade will be found a desirable addition to any carpenter's kit. Difficulties are always encountered where a piece of work having a concave or convex surface must be marked and cut, and a miter-box is not always available or can be used.



A thin flexible blade for curved surfaces

With the flexible-blade try-square shown in the sketch, such stock as the much-used curved wainscot-cap can be as easily marked as flat stock. "Cupped" or warped lumber, always difficult to work with an ordinary square, can be accurately scored without any trouble whatever. Even many large mouldings and coves can be marked with this square.

The entire expense is the cost of a piece of steel for the blade. The handle is easily made from any suitable hardwood scrap. Procure from a hardware house a strip of No. 26 gage saw-blade steel 2 in. wide and about 4 in. longer than the desired length of the blade. Mark the parallel edges of the blade on this with a fine scratch-awl and trim off the superfluous material with a pair of heavy tin snips, which will be found to cut it very satisfactorily and smoothly, though it will be necessary to file the edges to a perfect true.

The finished blade should be about 1¾ in. wide if it is to be 6 in. long, and ⅛ in. wider for each inch added to the length.

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Slot one end of the handle with a thin saw. This slot will be about twice as wide as the thickness of the blade, and in order to fill out the remaining space, a square is cut off the end of the blade piece and doubled on the end of the blade to be fastened in the handle.

Put the blade end of the square in the vise, adjust the blade and handle to right-angle, tighten the vise, and drill three ¼ in. holes through the handle and blade. Insert three soft-steel or brass ¼-in. pins ⅛ in. longer than the thickness of the handle and hammer them until they are firmly set, when the ends can be filed down smooth and flush with the handle.—HENRY SIMON.

An Artistic Combined Sundial and Fountain

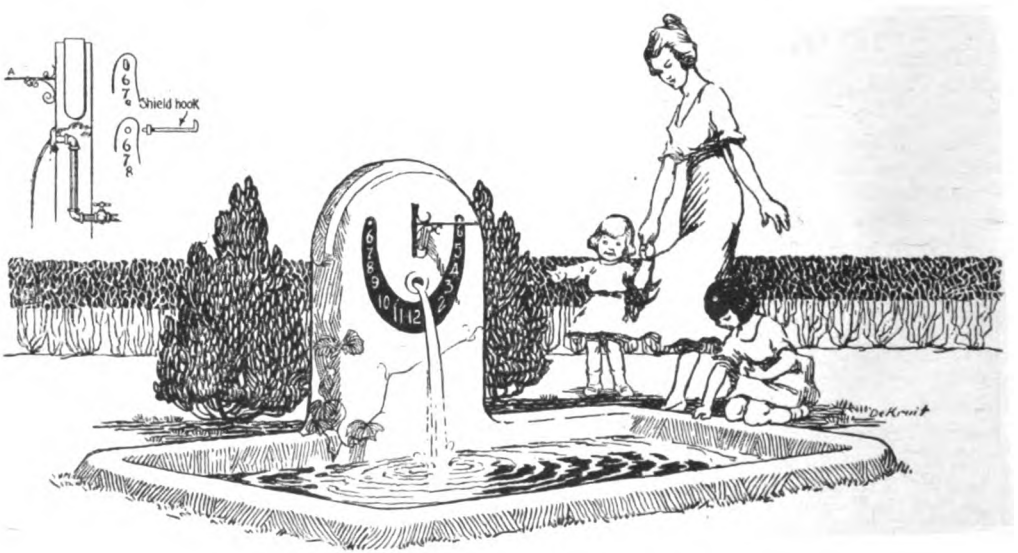
THIS sundial fountain may be easily and inexpensively constructed in concrete. The forms are simple and quickly built and may be further simplified by omitting the cap at the crest of the column. The hand or indicator *A* is made of non-rustable metal and is embedded in the concrete as are also the two hooks that support the upper ends of the metal numeral shield. The figures may be of any good stock design and they are mounted after their true position is proved on a day of good strong shadows. The mounting is easily accomplished with a drill and a small quantity of cement. The rust-proof fountain pipe is of course made with a column form and is provided with a cut-off at its base. The pool, which may be square or oblong in shape, is made of concrete. One side should be extended in the middle to form a column for the fountain.—W. B. SMITH.

How to Make Celluloid Stick on Wood, Tin and Leather

TWO parts of shellac, three parts of spirit of camphor, and four parts of pure alcohol dissolved in a warm water bath, give an excellent gluing agent to fix wood, tin, or leather to celluloid. The glue must be applied when warm to give the most satisfactory results. It should be securely corked when not in use.

Removing Pyrogallic Stains from the Fingers

A STRONG solution of chlorinated lime should be prepared, into which the stained fingers may be dipped for a few minutes. The fingers should then be rubbed thoroughly with a large crystal of citric acid. Apply the lime solution and acid alternately until the stains are wholly removed, and rinse the fingers in running water.



This concrete pool is fed by a fountain in a raised portion of one side on which hangs a sundial. This time-telling fountain must be set at a proper angle for the sun's rays

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Electric Devices and How They Work

IX.—Alternating current generator principles

By Peter J. M. Clute, B. E.

IN the consideration of the generation of electrical current, it is first advisable to study the fundamental principles of electromagnetic induction. It has been shown that a current of electricity flowing through a conductor sets up around the conductor a magnetic

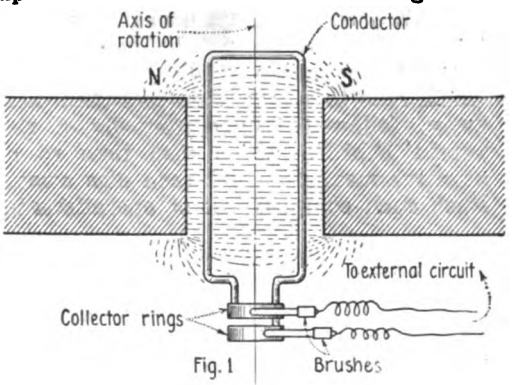

Diagram of an elementary single loop generator with wire ends attached to rings

field, which exists as long as the current flows. On the other hand, if we have a magnetic field, and wish to set up an electric current in a conductor, the wire will have to be moved in such a way as to cut lines of magnetic force. As long as the conductor remains stationary in the magnetic field no current will flow; in fact, even if the wire moves, but in a direction parallel to the magnetic lines, no current flows. Thus, it is found that the conductor must move and cut lines of force in order that an E. M. F. may be induced in it. If the conductor is moved slowly the induced E.M.F. is small. If the number of lines of force remains constant, the E.M.F. generated will be proportional to the speed with which the bar is moved. Thus, if the speed of the conductor remains constant, the E.M.F. will vary directly as the lines of force. Therefore, the E.M.F. of any dynamo can be raised or lowered by varying either the speed of the moving conductors or the intensity of the magnetization of the fields or by both.

The E.M.F. induced in a conductor is dependent upon the number of lines of force cut per second. Thus, if a fire cuts 100,000,000 lines per second, an E.M.F. of one volt is induced in it. The total E.M.F. of a generator is the E.M.F. induced in the armature conductors revolving so as to cut the lines of force of a magnetic field. In order to understand more clearly the generation of an electric current in the armature of a generator, let us consider a single loop of wire revolved between the poles of a magnet.

An elementary single loop generator is shown in Fig. 1. The ends of the loop are connected with two collector rings of brass or similar alloy, and brushes bearing upon the latter connect the coil with the external circuit. If this loop were revolved about the axis indicated by the dotted line through the center of it and in the magnetic field, a current would be generated which would be manifested in the external circuit either by heating or by its effect upon instruments placed in the circuit. A clearer idea of the nature of this current and the governing principles can be had by reference to Fig. 2, which represents an end view of the same loop in a vertical position.

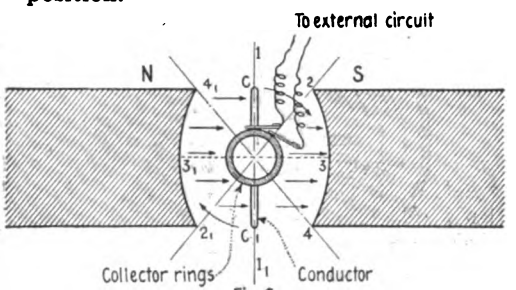

Fig. 2

End view of the single loop generator which shows clearly the governing principles

In Fig. 2, C C' represents opposite sides of the coil, which is revolved in the magnetic field at a uniform rate of speed. It will then successively move to the points 2 2′, 3 3′, and 4 4′ until C' is at

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the position now occupied by C; in this time the loop will have made one half a revolution. The E.M.F. generated in

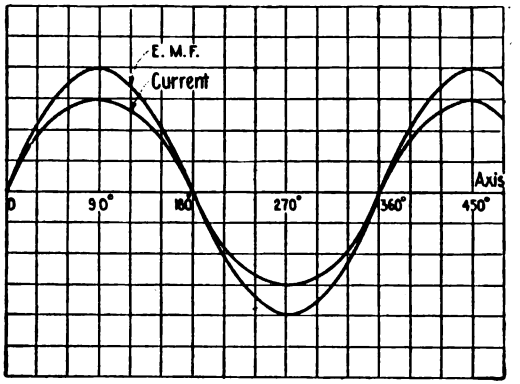

Fig. 3

Curves representing the rise and fall of the current and E. M. F. in an armature coil

the loop is proportional to the rate with which the magnetic lines of force are cut. By referring to Fig. 2, it can be seen that this rate is not uniform, since at position 1 the loop is moving for an instant practically parallel to the magnetic field and is cutting no lines of force. During the time of traveling from 1 to 2, the loop is not cutting nearly as many lines as during the time it moves from 2 to 3. Thus, when the loop is in position 1 1′ no E.M.F. is generated, but as it passes this position it begins to gradualy rise

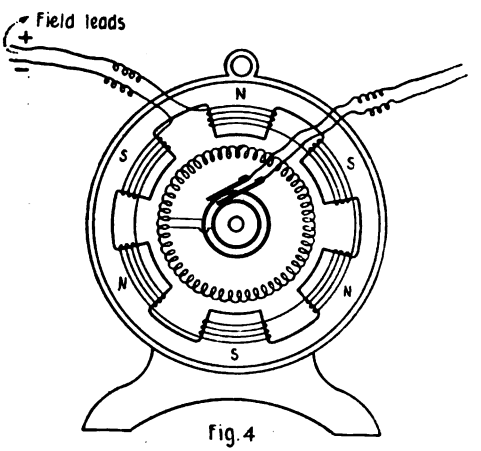

Fig. 4

An alternator with a stationary field outside and an armature rotating with shaft

until C is at 3, when it begins gradually to fall until C is at 1′ when it is again zero. When C moves past the position now occupied by C' the E.M.F. generated begins again to rise, but in the opposite direction, due to the fact that the lines of force are now being cut in the other direction.

The rise and fall of current and E.M.F in an armature coil revolving in this manner can best be illustrated by means of curves similar to Fig. 3. Everything above the axis represents E.M.F. and current in one direction and below the axis in the opposite direction. The current produced is what is called an alternating current, because it alternates through a complete cycle in one revolution of the armature. In each whole revolution there will be an E.M.F. which rises to a maximum and then dies away, followed immediately by a reversed E.M.F., which also rises to a negative maximum and then dies away. Each such complete set of operations is

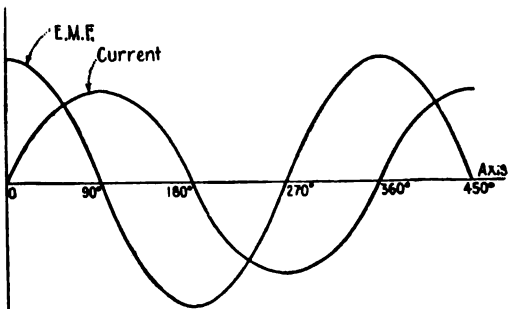

Fig. 5

A curve showing the lag of the alternating current behind the E. M. F. due to inductance

called a period, and the number of periods or cycles per second is called the frequency of the alternations. In bipolar machines, the frequency is the same as the number of revolutions per second, but in multipolar machines the frequency is greater, in proportion to the number of pairs of poles.

In Fig. 4 is shown a sketch of an alternator with a stationary field outside and an armature rotating with the shaft. To secure good insulation, high E.M.F. and sufficient frequency, A.C. dynamos are usually multipolar. The field magnets are fastened to the iron frame and are wound so that they are alternately N and S poles, the field current being supplied by a supplementary D.C. dyna-

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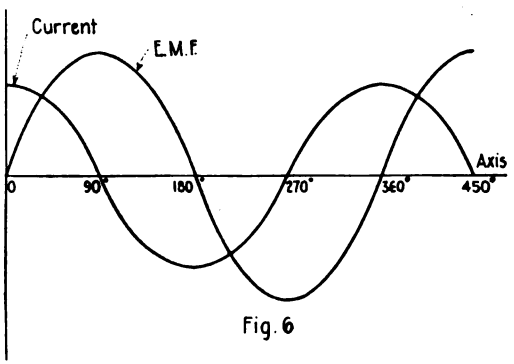
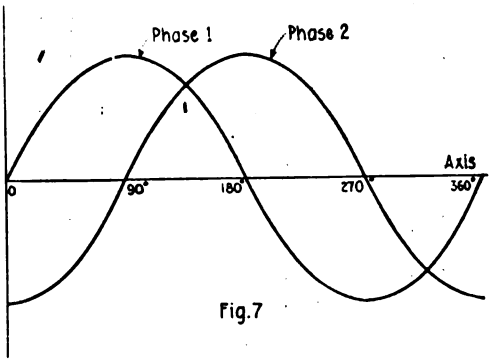
mo, called an exciter, or by a separate source of direct current. The armature is made up of thin iron laminations, with teeth around the periphery, assembled on the shaft, the slots forming grooves in which the arma-windings are placed. As an armature coil moves from under an N-pole to an S-pole, the lines of force through it are reversed, and E.M.F. is induced, and this occurs simultaneously in all the coils. The armature windings may therefore be joined together in series, taking care that when thus joined they will act together, and the resultant E.M.F. will be the sum of the E.M.F.'s induced in all the coils. If a low E.M.F. is desired, all the coils may be connected in parallel. In either case, the ends are connected with the two insulated slip rings upon which rest the brushes, which are connected with the external circuit.



This curve illustrates the current leading the E. M. F. due to the capacity in the circuit

Since the rotation of the armature with respect to the field is only relative, it makes no difference in the generation of E.M.F. whether the armature or field is made the rotating member of the machine. In either case, the stationary member is always called the stator, and the revolving member is always called the rotor. In large alternators, the armature is stationary and the field rotates within. This construction permits of better insulation of the armature windings in the stationary member of the machine and avoids the transmission of high voltage by sliding contacts on slip rings.

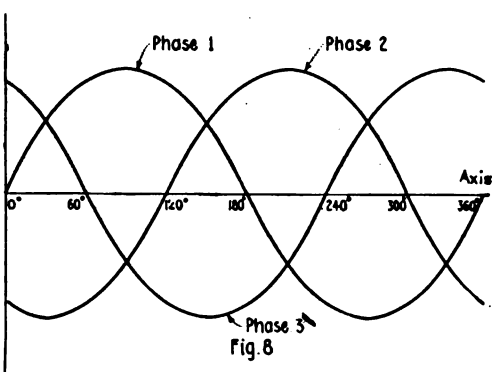
It has been established that self-induction in any circuit causes an E.M.F. contrary to an increasing current and with a decreasing current. In alternating currents, it has a two-fold effect: First, it causes an apparent increase in resistance to flow of current; and second, it causes the phase of the current to lag behind that of the E.M.F. In other



A graphic representation of two-phase currents is shown in this diagram

words, the current does not reach its maximum value at the same instant that the E.M.F. is a maximum, but a certain fractional part of a period later, which part, expressed in electrical degrees, is called the angle of lag. In Fig. 5 is shown the effect of inductance in a circuit. If we have capacity in an A.C. circuit, the current will lead the E.M.F. in phase, as illustrated in Fig. 6.

In the generation of alternating current, two or more currents of the same frequency of alternation, but differing in phase, may be obtained from one generator. Polyphase currents are



Currents developed in three-phase alternations are related as shown in these curves

especially useful for the economical transmission of power and for driving induction motors. At the same time they are just as useful for lighting purposes

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as the current from a single-phase generator.

In an alternator delivering two-phase currents, there are two sets of armature windings, one set being displaced from the other by half the pole pitch. Therefore, it can be seen, that the two E.M.F's induced in the two sets, while of the same frequency, will differ in phase by a quarter of a period. A graphical representation of two-phase currents is shown in Fig. 7. Referring to the latter, we find that when one of these E. M. F's passes through its zero value, the other will be at its maximum. In the two-phase alternator, four line wires must be used, since each phase is separate in its relation to the other.

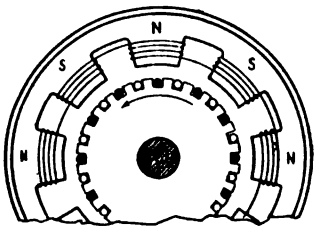


Fig. 9
The armature coils are laid in slots

The three-phase alternator has three distinct sets of armature windings, displaced from one another around the periphery by two-thirds of the pole pitch. Thus, there are induced three E.M.F's of the same frequency and of equal amplitude, which differ by one-third of a period in phase. Three-phase currents require only three lines, and not six, as would perhaps be inferred from previous considerations. Currents developed in three-phase alternators are related as shown diagrammatically in the curves of Fig. 8. In this case, the sum of the currents in any two of the three line wires at any instant is equal and opposite to the current in the remaining line wire. Therefore, the algebraic sum of the three is always zero. Thus, if one end of each winding is brought to a common junction, and the other ends are connected respectively with the three lines, no other return wire is necessary, since each line in turn serves as a return for the other two.

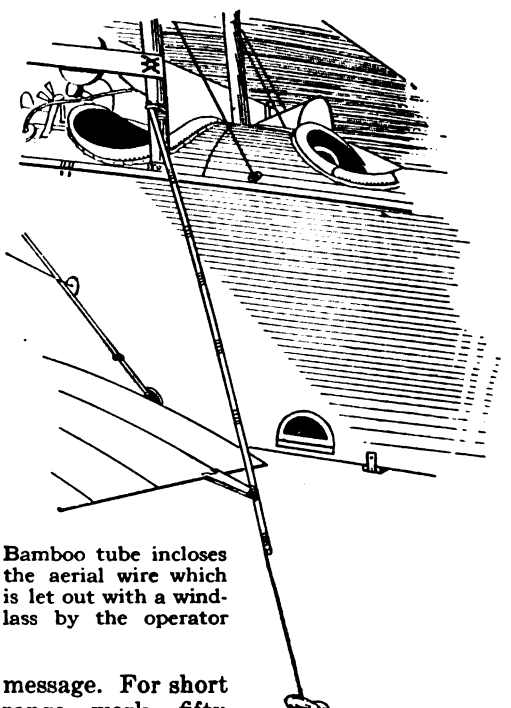
In actual practice the armature coils of alternators are not wound upon projections, but laid into slots as indicated in Fig. 9. Sometimes each slot contains but a single wire; sometimes there are many conductors. The number of slots per pole also varies. For two- and three-phase alternators two or three symmetrical windings are arranged either upon the rotor or the stator. This illustration shows three slots per pole, or one slot per pole per phase, and this armature is designed for three-phase generation. These coils are connected with collector rings in such a manner that in the external circuit they are in opposite directions, one wire always forming the return for the other two.

(To be continued)

How the Airplane Carries the Aerial for Radio Communication

THE aerial is coiled on a windlass in the radio operator's portion of the airplane fuselage, or body, and is run out through a silk wrapped bamboo tube. A lead weight shaped like a torpedo, to hold it nose-on into the wind, is fastened to the end of the aerial to carry it downward.

When in the air the aerial is let out to whatever length is needed to send a message. For short range work, fifty feet or so is sufficient, but for long range communications several hundred feet of wire may be used. Whenever the craft is about to land the aerial is drawn in as shown in the illustration.



Bamboo tube incloses the aerial wire which is let out with a windlass by the operator

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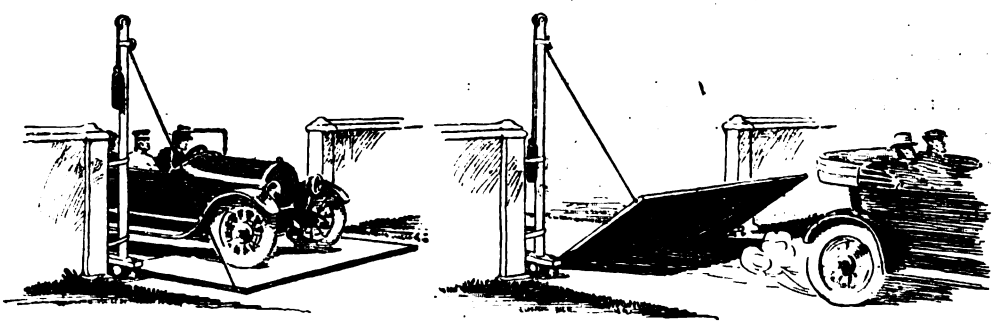
The Automobile Opens and Closes the Gate Automatically

THE accompanying illustration shows a gate which is automatically opened and closed by the automobile itself, thus making it unnecessary for the driver to stop his car, climb out and open the gate and then stop again and close it behind him. To operate the gate slow down until the car is almost stopped as its spring hangers are about to touch the gate. Then give the car gas and it will go over the gate, which is automatically closed again by means of the counterweight.—JOHN PETERS.



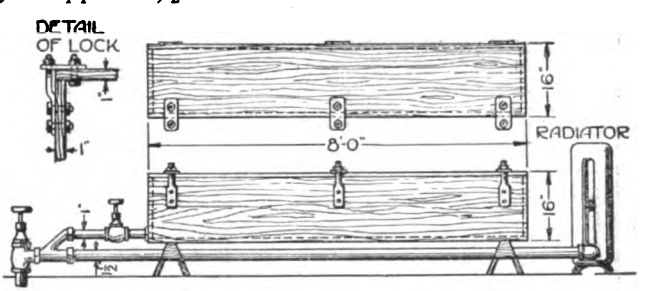
The gate is hinged on the ground and is pushed over by the automobile. A counterweight heavier than the gate raises the latter to an upright position

Restoring the Elasticity of a Paint Brush

SOAKING a hardened paint brush in a strong alkaline solution will soften the paint so that it can be washed out, but it will also soften the hair and render it flabby. This will surely happen if the brush is left in the solution too long. This was what happened to a brush a painter had forgotten, and after washing out the paint he thought he would see what effect vinegar would give to remedy the trouble. After working vinegar into every part of the hair and washing it out in clean water he found that the hair had regained its former elasticity. Of course the acid neutralized the alkali. This treatment is superior to that which calls for boiling water and turpentine.—JAMES M. KANE.

A Steaming-Box Heated by a Shop Heating Plant

THE illustration shows a very cheap, easily installed and practical steaming-box. The idea for making this box arose out of necessity to devise a method of steaming some ash wood to bend for skis for the boys. Such a box may be used for various steaming operations. A radiator was in use in the shop room. The radiator pipe led off about 10 ft. to one corner and was about 6 in. from the floor. A box was made up of cypress lumber 1 in. thick, 16 in. wide and 8 ft. long, and was set over the steam pipe on two trestles. Then with a drainage Y-fitting a branch pipe was run into the bottom of the box. This pipe was provided with a stop-cock, so that when not in use the steam could be turned off. The lid was fastened tightly in the rear with 5-in. hinges and in the front with clamps made of three small iron straps ½ in. thick with holes drilled to fit over bolts projecting from the sides. A box like this can be installed anywhere where there is hot water or a steam radiator or pipe with small steam pressure.



A practical steaming box to prepare wood for bending is attached to the heating system

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The Construction of a Simple Parallel Rule

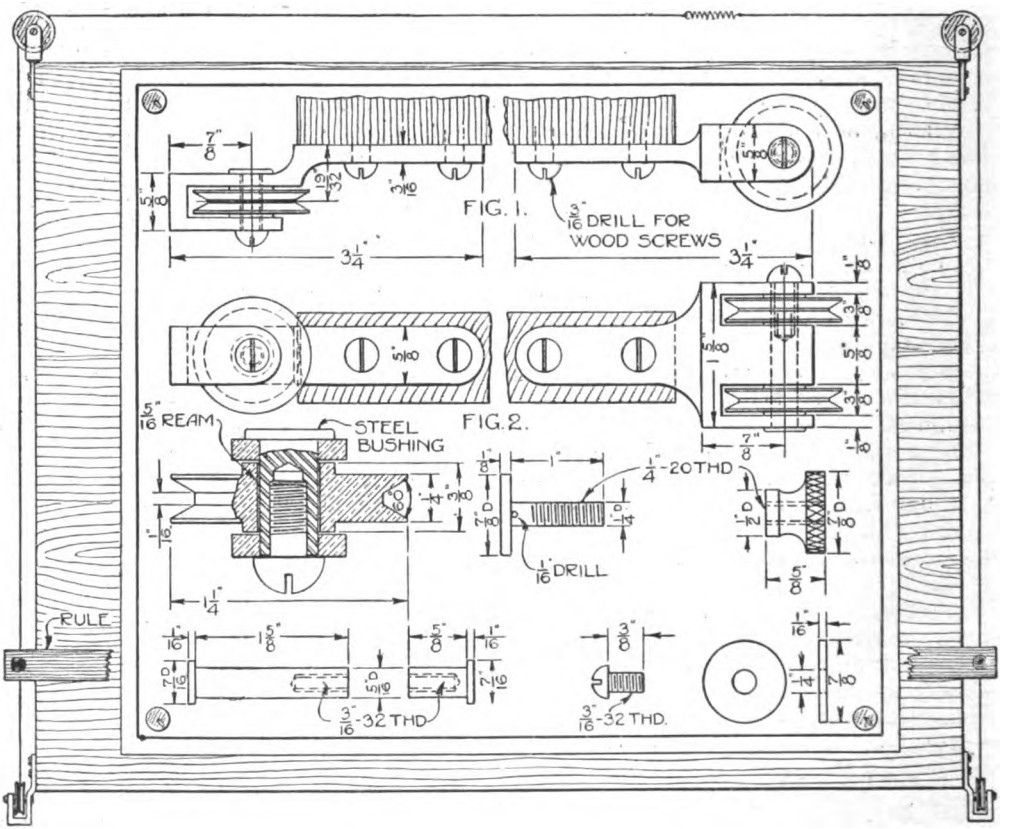
THE ordinary T-square may be of extra fine construction, yet it is almost a nuisance on the drawing-board; for the operator must constantly reach to the left to see if the head is against the edge of the board, and it is almost always necessary to hold it while drawing the lines. The only available substitute is the parallel rule, and the illustration shows the simple construction of one of these rules and how it is attached to the board. It has very few moving parts and they are affected little by wear. If the pulleys are made true, the rule will do surprisingly accurate work without any of the trouble which attends the use of the T-square.

It is not necessary to follow the dimensions accurately except to get the slots the right size, so that the pulleys will not bind. If a neat instrument is desired it should be made of brass and finished to the dimensions given.

Patterns should be made for the brackets, the slots being cast solid and milled out later. If no brass rod large enough to make the pulleys is at hand, a piece of 1⅜-in. shafting about 5 in. long can be used for a pattern, and a piece cast in brass.

The brackets can be finished with a hack-saw, file, and grinder if no milling machine is at hand. The principal dimensions are the distance between the centers of the two pulleys shown in Fig. 2 which is 1 in. and the distance from base-line to the center groove, Fig. 1, which is 19/32 in. These two dimensions are dependent on the bottom diameter of the V-groove in the pulleys, which is 1 in. in diameter.

The bushings are of cold rolled steel shafting. They should be turned to a



Attachments for the ordinary drawing-board to make a parallel rule. This rule is preferable to the usual T-square, which is quite a nuisance on large work

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light press fit in the brackets. The hole in the end is drilled, tapped and counterbored till the machine-screw head fits tight against the end of the bushing. The bushing should be flush with the face of the bracket.

The pulleys should be drilled, reamed and turned to about size before cutting them off from the solid rod. Now place the nearly finished pulleys on a 5/16-in. arbor, and turn to the required size. To get the groove right, grind a tool the proper shape, with the exception of the outside face, and use for the finish cut. Try the pulleys on the bushings and if they are too tight, ream with an expanding reamer till they run smoothly.

The "T"-square bolt and thumb-nut may be made as shown in the drawing or cap-screws and hex-nuts used instead. Care should be taken to have the little hole flush against the head or else the washer will shear the string off.

A straight edge is made out of a straight grained piece of wood or from an old "T"-square. It should be about 3 in. longer than the drawingboard.

A spring about 3 in. long is required and can be made by cutting off a piece of a screen door spring.

The best cord to use is "shoe-makers' linen," which can be secured at any shoe shop. Get the heavy kind used for sewing soles and do not wax it.

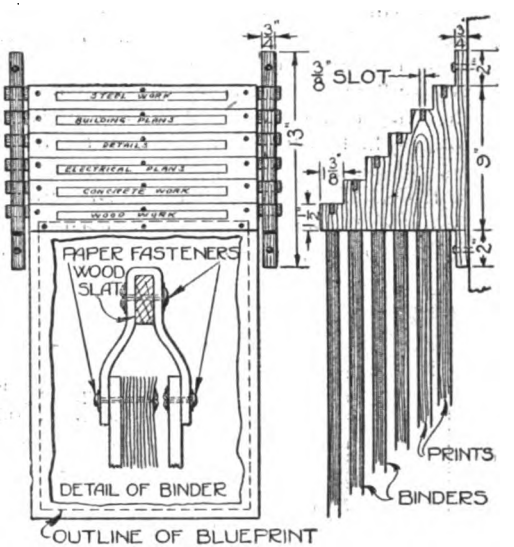
Put the device on the board, as shown in Fig. 1. The brackets should be securely attached to prevent any slight movement. The strings that go across the top of the board, cross between the pulleys. Those on the sides run parallel. With the spring inserted in one of the top cords the entire cord system becomes continuous. The "T"-square bolts are strung on the top cord, on both sides of the board. Measure the distance between the cords on the sides and drill holes in the straight edge, to this dimension large enough for the bolts to go through easily. Put a washer on both sides of the straight edge and screw up the thumb-nuts. Adjust the position of the spring so that it is in the center when the straight edge is in the center of the board.

The straight edge may be set at any small angle by loosening one thumb-nut and sliding up or down.

A Handy Blueprint Binder and Filing Rack

In most offices of drafting-rooms where many blueprints are constantly used for reference a system is needed to keep track of the prints. If they are left promiscuously in the drafting-room it is difficult to find the one you need in a hurry.

A neat way of filing the prints is shown in the illustration. Two wooden racks



Binding office blueprints and filing them in a handy rack for ready reference

are cut as shown in Fig. 1, and are fastened to the wall with four wood screws. The distance between the racks will depend upon the width of the blueprint binders used. In Fig. 2 is shown the detail of the blueprint binder. The stiff covers are of cardboard and are covered with black cloth to give them a neat appearance and to enable them to withstand the frequent handling.

The paper fasteners hold the cover to the leather or any other flexible material. The covers will bind the blueprints together. A slot ¼ in. by 1 in. is riveted or fastened with paper fasteners in the upper part of the hanger.

These binders may be indexed as shown in the drawing. They, together with the rack, will be found as serviceable as more costly ones.—Frank Harazim.

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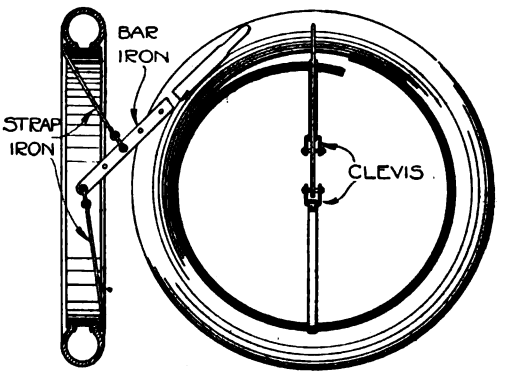
A Contrivance Which Will Remove Your Tire with Ease

THIS simple tire remover is made from two pieces of 3/8 in. strap iron 1 in. wide and 14 in. long and a piece 4 ft. long, 2 in. wide and 1/2 in. thick. The latter piece is used for the lever to which the



A lever toggle for drawing the rim from opposite sides so as to remove the tire

other two pieces are attached with clevises. The center clevis straddles the lever and the pin is inserted through a hole to make the length suitable for the rim size. Several holes are bored in the lever for these adjustments. The end of the lever is shaped so as to make a bearing for the end clevis.

An eye is shaped in one end of each piece of iron to take the clevises. The opposite ends have a hook to catch in the rim edge. The rim is stood on the floor or ground and the irons hooked into opposite sides of the rims, one at the top and the other at the bottom. The tire is released by pressing down on the lever.—LAWRENCE F. ASHLEY.

Cleaning Glass Surfaces Without Leaving a Stain

THE best method to clean glass—for instance, the interior of a bulb or flask—is to wash it in turn with chromic acid, distilled water, and alcohol. Sometimes a mixture of alcohol and ether is used in place of the alcohol alone. Caustic potash or soda will clean certain things; but they themselves adhere to glass, and must be removed by a most thorough rinsing with water.

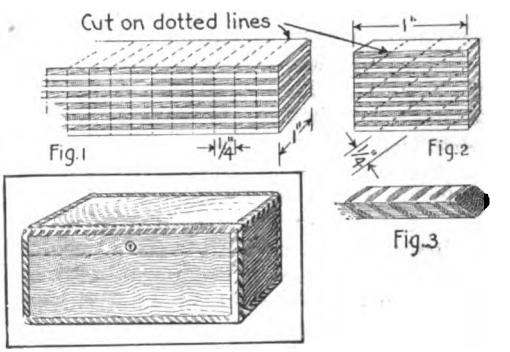
In some cases it is necessary to use hydrochloric acid, or even nitric acid, but this rarely happens. If nitric acid is employed, the operation should be carried on under a hood, so as to remove the noxious fumes.

Chromic acid, as used in the first method, consists of 10 parts water, 1.5 parts potassium bichromate and 4.5 parts sulphuric acid. It may be used over and over again for cleansing purposes.

An Effective Use of Veneer on Gift Boxes

SMALL gift boxes or chests are favorite articles with the amateur craftsman. A distinctive touch may be added to these boxes by the use of veneers in making an inlaid variegated border around the edge of the box. There are several operations in preparing the veneers, but they are not difficult and the result will pay one for the time spent.

Secure from any furniture factory or at a mill some scrap or a piece of veneer of any variety of wood. Cut this into strips 1 in. wide (any length), glue with thin cabinet glue, placing alternate strips of light and dark wood together as in Fig. 1. Saw these into sections 1/4 in. thick as in Fig. 2, then saw these sections diagonally into strips 1/4 in. square as in Fig. 3. Square the ends of the



Manner of cutting strips of veneer to set in grooves for making inlay work on wood

strips. Groove the top, bottom and front edges of the box a little less than 1/4 in. deep, being careful to make the cut straight. Insert the pieces and glue them in place, keeping all joints true. With a sharp plane work them down flush with the box surface. Round all edges and finish with fine sandpaper. The result is a pretty box.—GEORGE L. FURSE.

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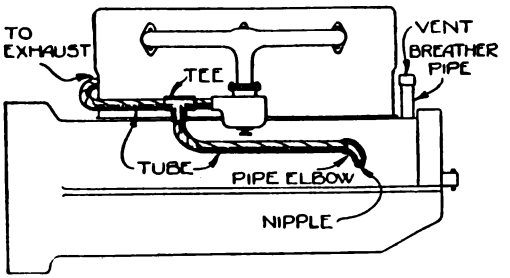
A Homemade Fuel Saver Attached to Automobile Engine

FOR making and attaching this fuel saving device drill a 1-in. hole in the upper part of the crank case on the same side of the motor as the carburetor and as near the breather pipe as possible.



Pipe connection of crank case with heater on the exhaust for making a fuel saver

If the breather pipe is one of the kind fitted with a tight cap a ¼-in. hole should be drilled in the cap to form a vent so that a vacuum is created in the crank case. Next tap the hole in the crank case and screw in a piece of pipe about 1½ in. long. Solder over the end of this pipe that goes into the crank case a piece of fine screen. Now secure a piece of 1-in. flexible tubing, such as is used in connecting the carburetor to the exhaust manifold. Fasten one end of this tubing to the pipe screwed into the crank case. The other end must be brought up to the air opening of the carburetor and fastened to it, but in such a way as not to interfere with the free flow of air. A good way to do this, if your carburetor is fitted with a hot-air pipe to the exhaust manifold, is to cut this pipe near the carburetor and fit a tee as in the illustration. After this has been done your saving device is finished and it will draw all of the explosive vapors from the crank case through the carburetor into the motor in the form of gas. After you have installed the device start the motor and let it warm up. You will soon notice that your motor is getting a very rich mixture. This is due to the vapor being drawn from the crank case. Close the needle valve on the carburetor until the motor runs as usual. In cold weather keep the carburetor choker closed a few seconds longer than usual, until the motor warms up slightly.—W. D. THOMPSON.

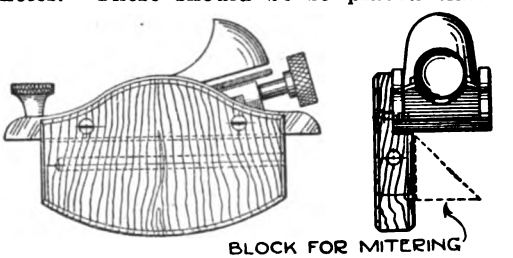
Making a Block Plane Into an Edge-Trim Plane

FOR accurately squaring long end-grain edges, such as the side of a table, an edge-trim plane is a great convenience. It is almost a necessity where the edge to be trimmed is not square but beveled.

Here is a way to make your block-plane instantly convertible into a very efficient edge-trim plane at no expense and with only half an hour's work:

Take a piece of hardwood, preferably maple, applewood, or rosewood, 4 in. wide by 2½ in. long, and along one end-grain edge form a rabbet ¼ in. deep and as wide as the extreme height of the sides of the plane. Be sure that the face of the rabbet is smooth and parallel with the sides of the block. Put the block with the rabbet against one side of the plane, mark the outline of the side, and cut it out with a coping-saw. Saw the other end of the block out in a semi-circle, and round off all exterior edges. Bore a ¼-in. hole through the entire width of the block ½ in. below the rabbet, and drive into this hole a pin tightly fitting it, and which can be easily cut from a large spike. The purpose of this pin is to prevent the block from breaking if it should be accidentally dropped.

Through the sides of the block, about 1 in. away from the edges, drill two small holes. These should be so placed that



The fence as it is attached to the side of a block plane to make an edge plane

when they are continued into the side of the plane, they will emerge just above the bottom. Thread the holes in the plane for machine screws or stove bolts.

It only takes half a minute to screw this attachment into place or take it off again. The wide, rounded block furnishes a firm and convenient hold for the hand so that it is easy to keep the plane

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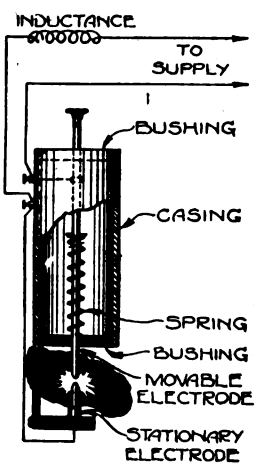
perfectly square with the work. For miter or bevel work, it is only necessary to screw wooden blocks of the proper shape against the inner face of the block.

This attachment does not interfere with the ordinary use of the block-plane in any way nor do the screw-holes weaken or deface it. Furthermore, the fence can be made attachable to either side of the plane, by providing screw-holes in both sides. Again, the wooden fence slides over the work with a minimum of friction, performing the task assigned to it with perfect ease as well as absolute accuracy.—HENRY SIMON.

An Electric Gas Lighter for the Laboratory or Factory

IN laboratory and other places where gas is used at frequent intervals, a simple electric gas lighter is not only a necessity but also a convenience.

The casing of the lighter described is of hard rubber or fiber, sawed as shown in the diagram. The bushings are preferably of the same material, or can be made of impregnated hard wood. The movable carbon electrode is fitted with a knob and is kept separated from the stationary electrode by a spring clamped to the carbon as shown.



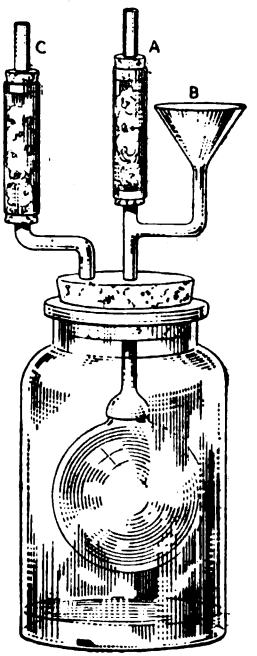
Fiber barrel with electrodes for making a small arc

Connections are given in the diagram. The inductance coil is used on A. C. circuits and a resistance coil on D.C. circuits. The inductance can be varied by the number of turns required for different frequencies; it can be made by winding a number of turns of insulated wire around a soft iron core.

Pressure on the knob brings the two electrodes into contact and upon relieving the pressure a little an arc is started across the gap, sufficient to ignite the gas.—PETER J. M. CLUTE.

How to Protect a Soap Bubble and Keep It for Weeks

LASTING soap bubbles cannot be made unless the air inside and outside the bubble is almost free of dust particles and is saturated with moisture. Wherever you are the air is dust-laden so that the whole blowing apparatus must be conducted inside of a large cork. It is necessary to pass two glass tubes through the cork into which larger sections of glass tubes are placed, as shown in the illustration, which inclose cotton wool filter. The soapy water and air enter through the tube, *A*, the liquid entering the by-pass tube, *B*, below the air filter. The other tube, *C*, is to allow the displaced air to leave the bottle. This tube also provides for air movements due to variations in temperature and barometric pressure. A small quantity of water, *D*, is placed in the bottom to keep the air moist.



A large bottle inclosing an air bubble

A Reliable Solution for the Electro Deposition of Aluminum

ALUMINUM is at best an uncertain metal with which to make an electro deposit. The following formula, however, has been found to be quite reliable. Dissolve 50 parts by weight of alum in 300 parts of water, and add 10 parts of aluminum chloride. The resultant solution is heated to 200 deg. F. and permitted to cool. When cold, 39 parts of cyanide of potassium are added. When plating with this prepared solution it has been found best to use a feeble current.

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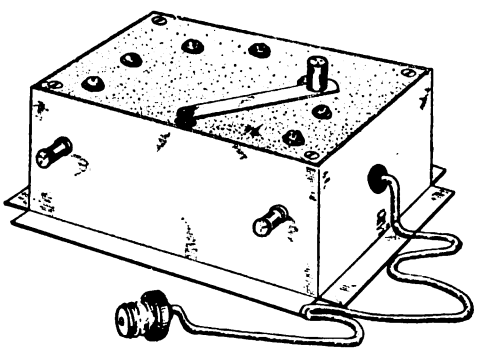
Making a Toy Transformer

A simple method of making the now much used bell-ringing transformer

By W. A. Hirsch

THE transformer described in the following article is known as a toy or bell-ringing transformer of the shell type. It can be attached to a lighting circuit of 110 volts and the current stepped down to 12 volts. It is used for ringing bells, running small electric motors, miniature lights, railways, etc. Building it will prove instructive as well as enjoyable for the young electrician.

It will not be necessary to go into detail with regard to the magnetizing and demagnetizing of a soft iron core when placed in a magnetic field that is produced by alternating current, as such terms and description probably would tend to confuse rather than assist in the construction of this simple transformer.



The toy or bell-ringing transformer of the shell type encased in a neat box

The transformer in general consists of a primary and secondary coil, in the center of and surrounding which are a number of laminations of thin soft sheet iron. The dimensions of the laminations are given in Fig. 1.

These strips are 11½ in. long and ¾ in. wide and enough of them are cut to make a pile ¾ in. high when tightly pressed together. They are then given a coat of very thin shellac. Cut two washers from a piece of insulating fiber 1-16 in. thick to correspond with the dimensions in Fig. 2. Cut from soft wood four pieces 2⅞ in. long with a cross-section as shown in Fig. 3.

Pile the shellacked strips up, and slide one of the fiber washers on them to within 4¼ in. from the end of the core, then the other washer to within the same distance from the other end, leaving a space of 2⅞ in. between the washers. Now place the four strips of wood between these washers on each side of the core and fasten in place with several layers of heavy insulating cloth or linen strips which have been first dipped in thin shellac. When this is done the core is ready to receive the coils.

The low tension side of secondary will have the larger wire and the smaller number of turns and will be wound on the core first. Secure about 5 oz. of No. 24 gage single cotton-covered wire and solder about 6 in. of No. 18 double cotton-covered wire and pass through a hole drilled in one of the washers as near to the core as possible. By allowing a drop of solder to form on the joint and pulling the heavy wire through the washer up to the drop of solder the joint will be made secure.

Wind on the core as evenly as possible about 312 turns, being sure to insulate layers with two layers of paraffin paper. Terminate this winding in the manner stated; namely, by soldering a 6 in. piece of No. 18 double cotton-covered wire to it; and don't forget the drop of solder. Drill a hole in the washer as close to the last layer as possible and bring out the heavy wire.

Should it be desired to have several different voltages, say 2, 4, 6, 8, 10 and 12, these can be had by tapping in on the secondary winding every 52 turns. To make this tap, scrape about ¼ in. of the insulation off and solder about 6 in. of No. 18 wire as described. Drill each hole in the washer as needed. Insulate each tap thoroughly and tag them on the outside of the washers, so that you will have no difficulty in wiring up the switch, to be described later.

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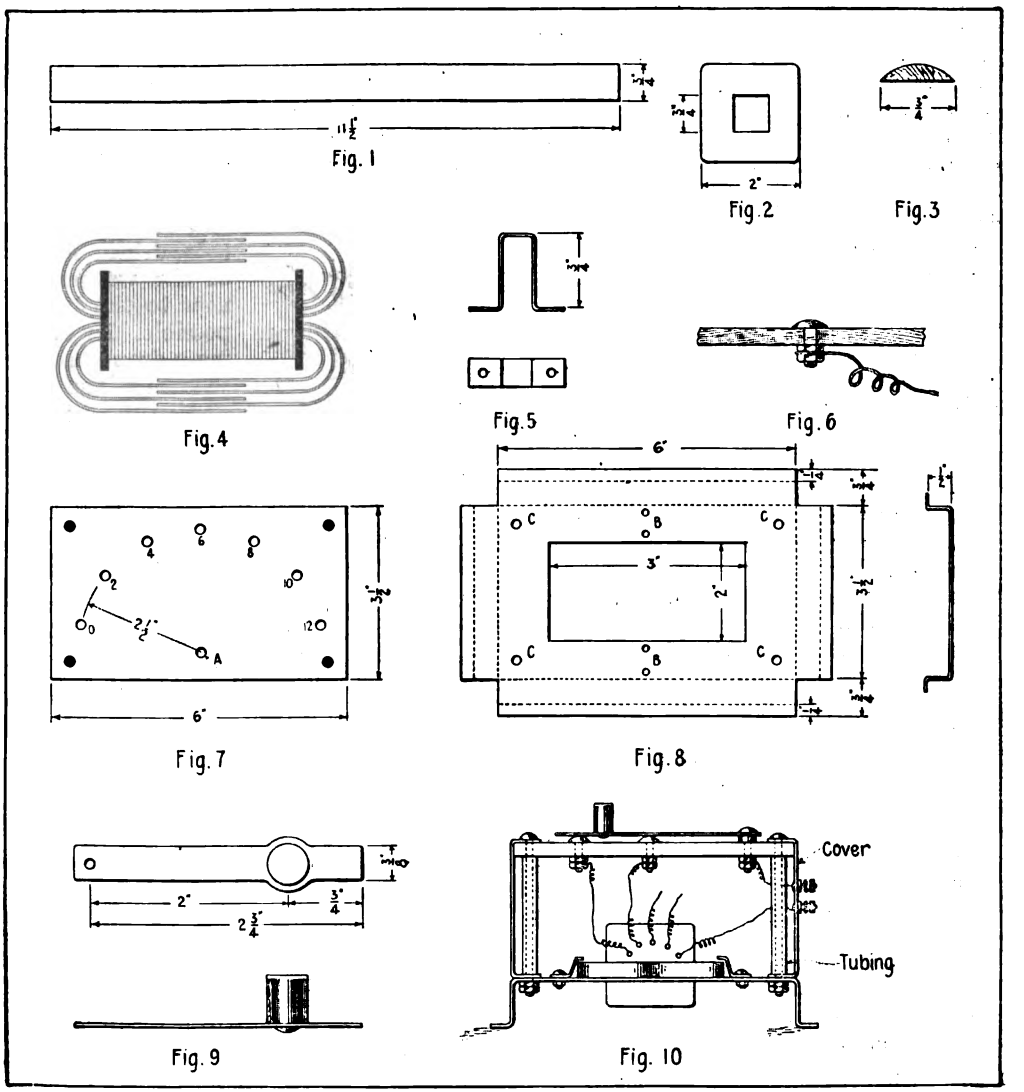
Over the secondary winding, wrap, say, three layers of heavy insulating cloth, shellacking each layer in order to prevent it from loosening.

You are now ready for the primary or high tension winding which requires about 3 oz. of No. 34 gage single silk-covered copper wire. This winding is started from the opposite end from the secondary and will have the heavy No. 18 wire soldered to its end and the drop of solder to protect the connection. This heavy wire is put through a hole drilled down close to the insulation of the secondary coil, and the fine wire is wrapped on as evenly as possible. It has about 240 turns to the layer. Wrap on 12 layers for this coil, insulating each layer with a sheet of paraffin paper and terminating the coil with the heavy wire as previously described. Give this coil a coat of shellac and over this put several layers of insulating cloth, shellacking the layers together. This gives a very good finish to the entire coil and also serves as a mechanical protection.

The winding being completed, proceed with the finishing of the core to form the



Details of the laminations and the parts for the construction of a small transformer for reducing the alternating current to a low voltage for running toy trains and ringing bells

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shell. First divide the core strips into two equal parts and bend back as shown in Fig. 4. Overlap each strip as far as possible, binding the ends with a piece of sheet iron bent in the form shown in Fig. 5 after having drilled through each end a ⅛-in. hole to facilitate mounting the completed coil and shell on a base.

For the switch, procure a piece of fiber about ⅛ in. thick, or a piece of wood ¼ in. thick (preferably fiber), of dimensions shown in Fig. 7. Drill ⅛ in. holes from 0 to 12.

Procure eight flat-headed brass screws, with washers and nuts—the kind used as binding posts on dry cells will do—and put one in each hole, attaching one of the wires for the different voltages to its respective binding post underneath the switch as shown in Fig. 6. The blade for the switch is made from a piece of strip brass about 1-16 in. thick and of the dimensions shown in Fig. 9. The handle is made of hard rubber, fiber or hardwood and a small rivet is used to hold it in place.

One of the ⅛-in. screws is passed through the small hole in the switchblade and down through the hole *A*, Fig. 6, in the switchboard and fastened on the other side with a spring washer and nut. The screw is then riveted over to prevent the nut from working off. The ⅛-in. holes drilled in the corners of the switchboard are for holding it in place as described later.

The transformer is now mounted on a sheet iron base as shown in Fig. 8.

As the diagram shows, it will require a piece of sheet iron 5 in. by 7½ in., cut and bent as shown. The center 3 in. by 2 in. is cut away to give good clearance for the coil. The ⅛-in. holes *B* are for the bolts that fasten the coil and shell, by means of the clamps to the base, and the holes *C* are for fastening the switchboard to the base. Small pieces of tubing about 2¾ in. long, slipped over the bolts, will act as dividers in keeping the switchboard up and away from the coil of the transformer. In Fig. 10 is shown the arrangement of the parts and how a cover can be placed over the entire transformer enclosing all parts except the switchboard. This cover should be at least ⅛ in. from any electrical part of the transformer.

The "line" wires or primary terminals can now be brought out of the case through porcelain bushings and connected with a light cord having an attachment plug on the end. There are only two binding posts on the low voltage circuit. One wire is run from the heavy wire at the starting point of the secondary circuit and the other wire is soldered to and leads from the ⅛-in. bolt holding the switchblade. These wires are fastened to binding posts on and insulated from the cover of the transformer. Be sure that all electric connections and binding posts are well insulated.

How to Make a Ventilating Potato Bin

To make this bin four sticks of fire wood, or other similar material are required for supports, and a discarded picture frame and a gunny sack. The sack

Gunny sack supported on a frame mounted on posts for a simple ventilating potato bin

is taken apart to form one thickness and tacked to the frame. The texture of the material is sufficiently open to allow plenty of good ventilation. If no picture frame is at hand make a frame of 2 by 4-in. stock.—Edward R. Smith.

Making a Paste for Coating Metal Surfaces with Silver

Dissolve pure silver, or a silver alloy, in cold nitric acid. If an alloy is used which does not contain lead, the acid may be warmed to hasten the process. Precipitate the silver with common salt until no more will separate from the solution. Make this precipitate into a paste by adding a little more salt, and cream of tartar. Apply this to the surface to be silvered with a cork and lacquer the article to prevent tarnishing.

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A Direct-View Finder for Hand Cameras

IN photographing moving objects with the ordinary hand camera, the reflecting view finder is not always satisfactory. When the object being photographed is over 25 ft. away, it appears very small in the finder, making it very difficult to place correctly in the picture.

It was made of just a screw-eye and the camera post

Many excellent pictures may be made with this type of camera without using the reflecting view finder. The method used is illustrated in the picture. All such cameras are equipped with a movable leg for leveling the camera in making time exposures. A small screw-eye, such as commonly used for shade cords, should be inserted in the side of the camera box and on a line with the leveling leg with the screw-eye's face parallel to the back of the camera, to which the leveling leg is at right angles.

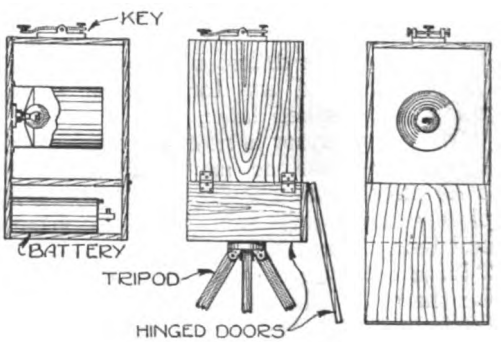
Use the screw-eye and leg as you would a gun sight, aiming at the object you wish to appear in the center of the picture. In the case of a moving object, you can follow it with the sights until you are ready to snap the shutter. After you have tried this method for a while you will neglect the regular finder, and seldom use it except for making portraits or views close to the camera.

One incidental advantage of the use of this method is that all pictures so made are taken from the eye level, and, especially on close views, appear more natural and true to life in the finished print. With the reflecting view finder all such views must be taken with the camera at the level of the waist. When the direct sighting method is used for taking close views, say a portrait at 6 ft., it is important that the camera be sighted at a point slightly above the waist of the subject, and the point aimed at will appear in the center of the finished picture.—JOHN F. MAHONEY.

A Blinker Telegraph Equipment for Boy Scout Work

SIGNALING by the flash of a light is a very practical method of communication over short distances at night. The small electric flash lamps run on dry batteries constitute a ready means of signaling in this manner and, with the use of a telegraph key in the line, a portable blinker set for Boy Scout work may be made as follows:

The box is made first with the dimensions shown, and provided with a separate compartment for holding two dry cells. A door is made for each of the two compartments; one opening on the front and the one for the dry cell compartment on the side. A large flash-light bulb is then mounted in a clean tin can with a small reflector placed behind it. The reflector may be of conical shape and formed from a piece of polished aluminum. The can is then mounted in the box and the light connected in series with an ordinary telegraph key and the batteries. The telegraph key is mounted on top of the box. A cheap camera tripod completes the equipment and, when used at half height, brings the outfit into a convenient position for the operator to manipulate the key while standing. The standard Morse or Continental code is used with this inexpensive and easily made telegraph equipment.



A small battery flash light placed in a box for sending signals with a telegraph key

A more powerful outfit, capable of transmitting signals several miles, can be made by using a storage battery in connection with a high candle-power light such as is used in the searchlights of automobiles.—RAYMOND FRANCIS YATES.

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